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THE

WHITIN MACHINE WORKS.

WHITINSVILLE, MASS., U. S. A.

1896.

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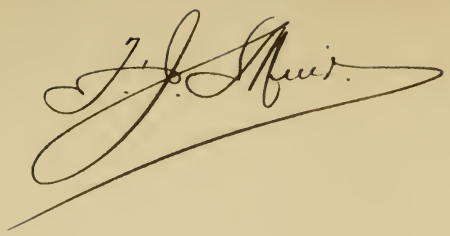

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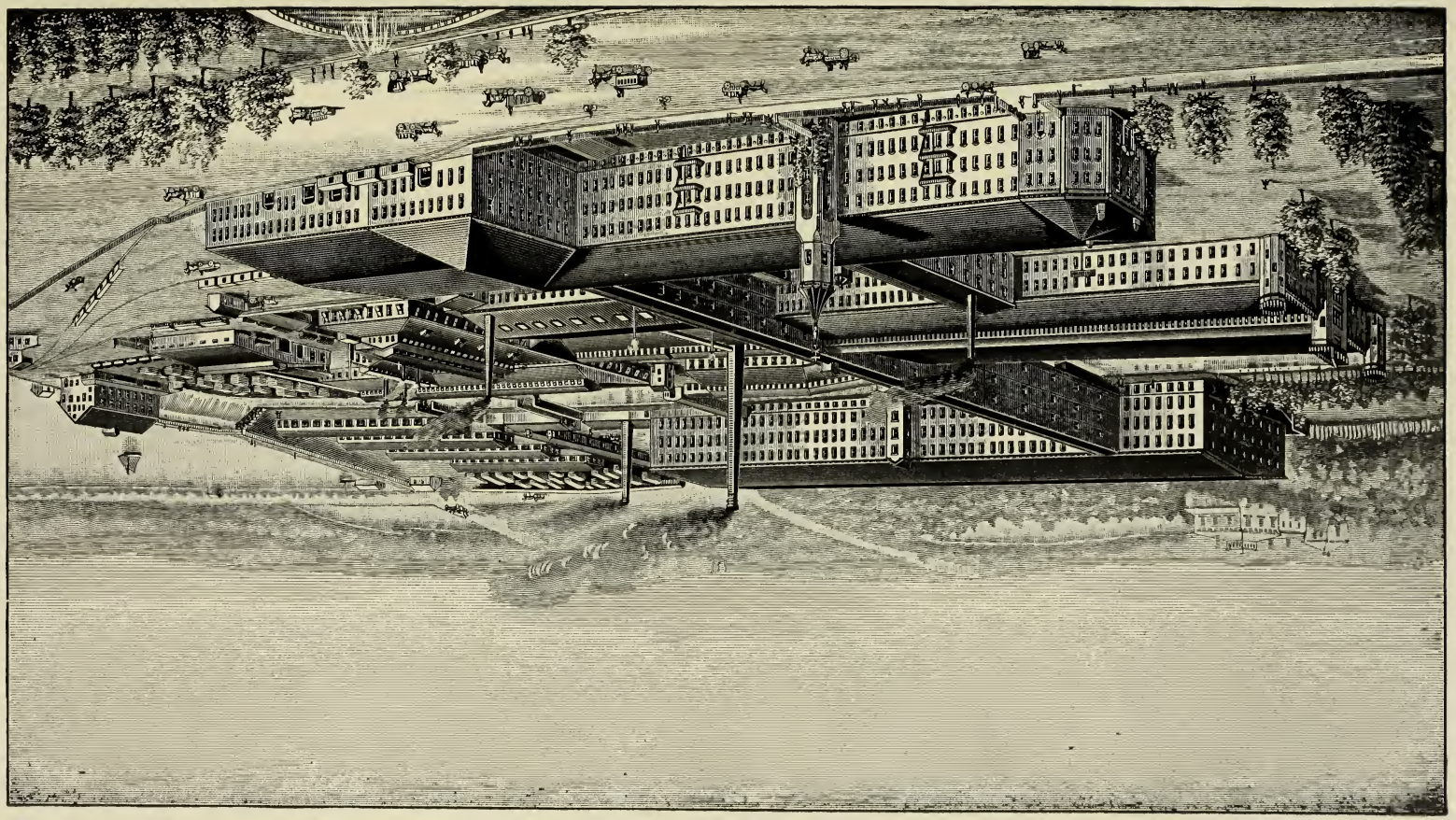

THE

WHITIN MACHINE WORKS

WHITINSVILLE, MASS.

BUILDERS OF

COTTON MACHINERY

Cards, Railway Heads, Drawing Frames
Spinning Frames, Spoolers, Wet
and Dry Twisters, Reels,
Long Chain Quilling
Machines, Looms,
Etc., Etc.

C. W. LASELL, President. G. M. WHITIN, Treasurer.
C. A. TAFT, Agent, J. M. LASELL, Assistant Treasurer.
W. L. TAFT, Superintendent.

1896.

PRESS OF
CHAS. J. BATCHELLER
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Flowers Collection
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1896

PREFACE.

In presenting this Catalogue to our patrons we have aimed to present the subject matter as simply and briefly as possible. We have therefore given only such information as would seem to meet the daily requirements of Agents, Superintendents, Overseers, and others, whose business requires rapid calculation, changes in yarn, etc. The many improvements recently made in our machinery, have rendered necessary new Tables of Production. These are based upon ten hours running time per day, with proper allowance for cleaning and stopping. This should be borne in mind when more or less than ten hours are worked. The figures we give can be attained under ordinary circumstances, and under favorable conditions can be exceeded. The prints of our machines with accompanying data, will enable persons to judge of their merits, and will also assist in setting up and working them. The Draught and Twist Tables will be found especially serviceable to those using the Whitin Machinery.

For the information of our customers it may be added, that the manufacture of Cotton Machinery was commenced here in 1831, and that our working plant, exclusive of tenements, etc., now comprises eleven acres of floor space, and gives employment to fifteen hundred men.

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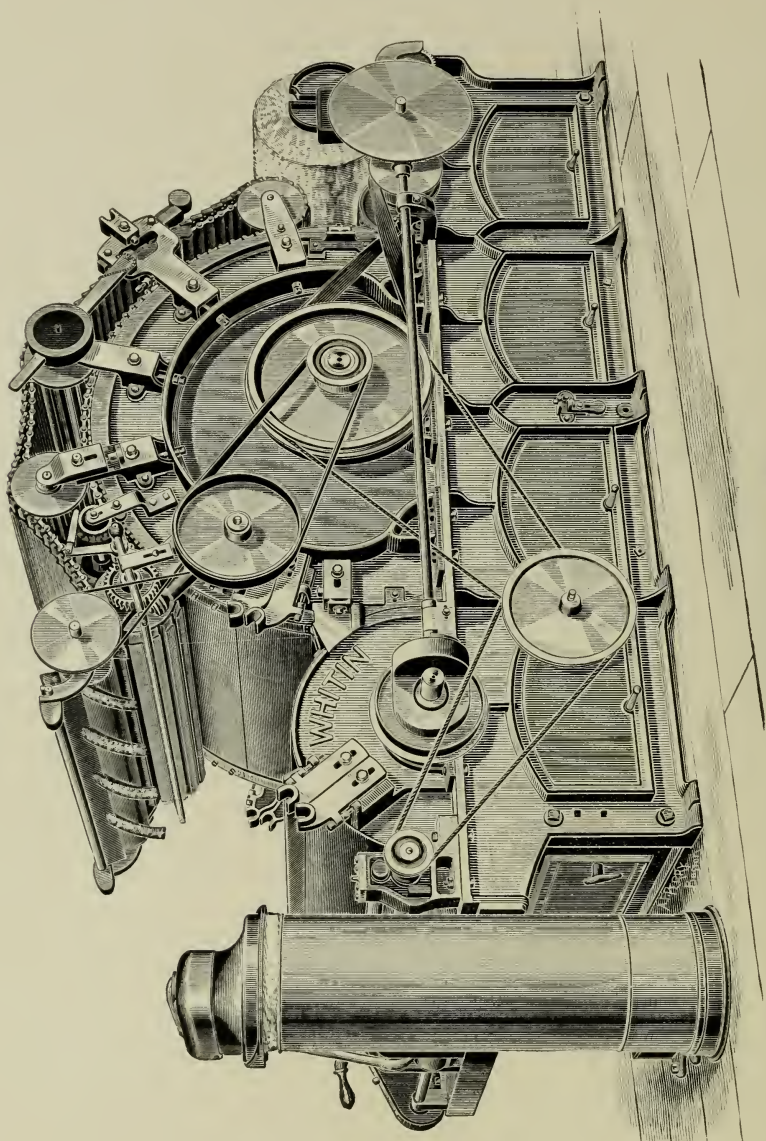
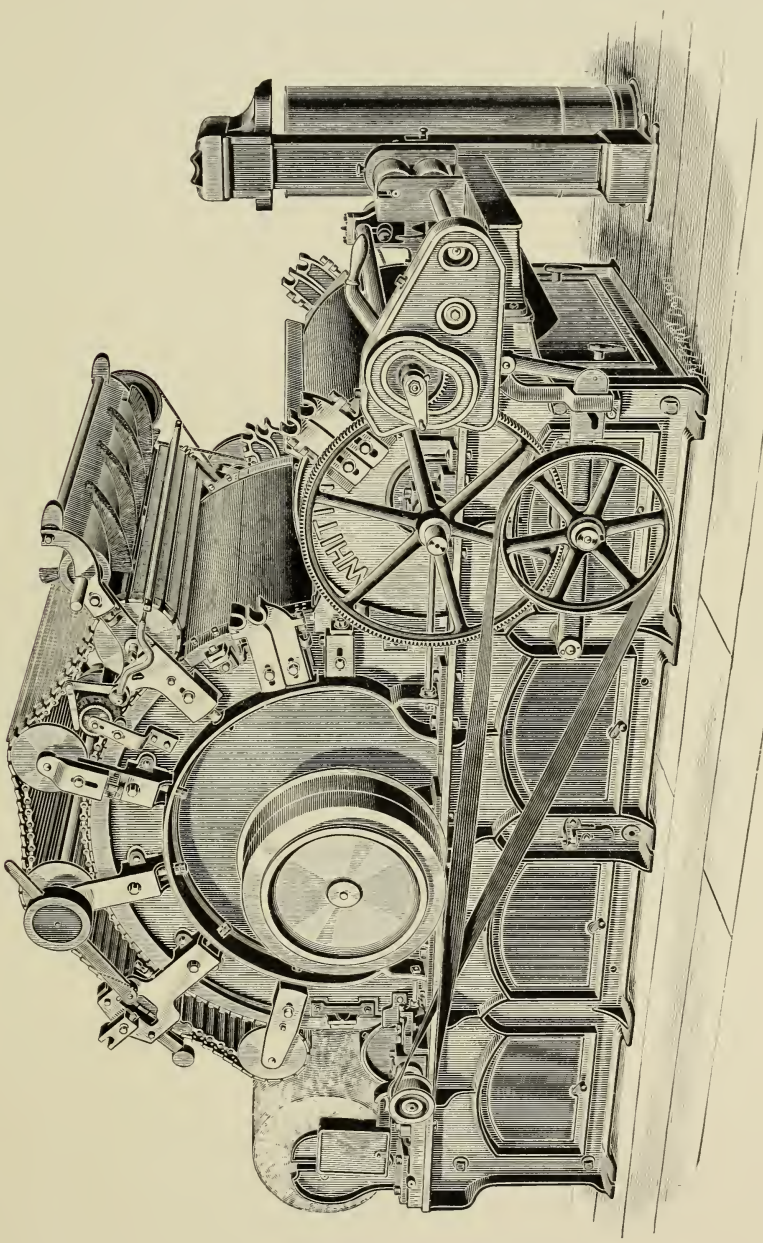


REVOLVING FLAT CARD.



REVOLVING FLAT CARD.

Revolving Flat Carding Engine.

The cylinder is 50 inches in diameter, 40 inches wide, and is made extra heavy and well balanced. It is run in pedestal boxes on bushings which can be renewed when worn, without requiring a whole new box.

The oiling is arranged so as to have free access to the cylinder bearings, and all surplus oil is led to one side and away from the cylinder, so there is no running out to the edge of the cylinder to make bad work with the clothing and wire. This leading away of oil after it has performed its use is an important feature and is introduced at a number of points on this card.

The doffer is 24 inches diameter, 40 inches wide, is balanced truly, and supported with a heavy shaft, to compare with the cylinder.

The licker-in is $9\frac{1}{2}$ inches diameter, 40 inches wide and clothed with metallic or Garnett wire clothing. The card frame and arch, or fixed bend, are made of heavy proportions and well ribbed to be stiff and not given to strains. This, coupled with the fact that the cylinder is ground perfectly true and balanced to double speed required, gives a card that shows no vibration in running, and enables parts to be set with greatest closeness.

The inner edge of arch, or fixed bend, is truly turned at the point where the edge of the cylinder comes, so that the arch can be set very close to the cylinder, thus stopping all chance for the card to make "side waste."

The turned edge of the arch extends a little beyond the edge of the cylinder and forms a protection for the card clothing from injury coming from the side. The flats are 104 in number, 39 of which are working.

Particular attention has been given to get a straight and well formed flat that will keep the position it is sent out in and not change about at any little influence that may tend to affect it. Flats are all ground to an even, smooth surface, and are subjected to almost no "straightening process." The grinding straightens the face the same as planing a casting does.

We believe a flat that is hammered, twisted or strained into a certain position will be striving to get back to its original position, and is more likely to change by a slight knock or fall than one that is not hammered. Hammering further weakens the flat.

Particular attention is also given to getting all flats exactly alike at point where they bear on the flexible bend.

Flats are all ground when sent out on the card, and do not need

grinding again till in the regular course of work they require it. By special arrangement with McConnel & Higginson, of Manchester, England, we are enabled to apply their patented device for grinding the flats. By this apparatus the flats are supported on the same face and in the same plane while being ground as they are while actually carding, and consequently the original pitch is maintained with perfect accuracy, and when the flats are in position on the flexible bend, all can be set by the same guage to the cylinder. We consider this device the simplest and best adapted to its purpose now in use.

The card is fitted with a high speed noiseless comb, that will comb the doffer at any speed likely to be run. The comb box is provided with an oiling tube, so arranged that the comb may be conveniently oiled while running at full speed, without removing any covers with consequent escape of oil.

Coilers used are for 10, 11, and 12 inch cans. The large size will be found the most preferable on account of holding the most cotton, and therefore requiring less renewing.

The card is well cased up and all exposed parts are polished.

The setting is accomplished by the well known flexible bend resting on three setting points, with two intermediate push points, so it is adjustable at five points on each side. The licker-in is provided with mote knives and short screen, all adjustable. The separation of leaf and mote from cotton at this point is essential, and in this card it is accomplished in the highest degree and without unnecessary waste.

We have added much new and special machinery for the production of this card, in order that in accuracy of workmanship and fineness of adjustment, it may be unexcelled by any in the market.

Driving Pulleys:—3 inches face, 20 inches diameter.

Clothing:— For cylinder 50 inches diameter, carding surface 40 inches wide, about 44 square feet, or 268 running feet, 2 inches wide.

Doffer:—24 inches diameter, carding surface 40 inches wide, about 21 square feet clothing, or 172 running feet, $1\frac{1}{2}$ inches wide.

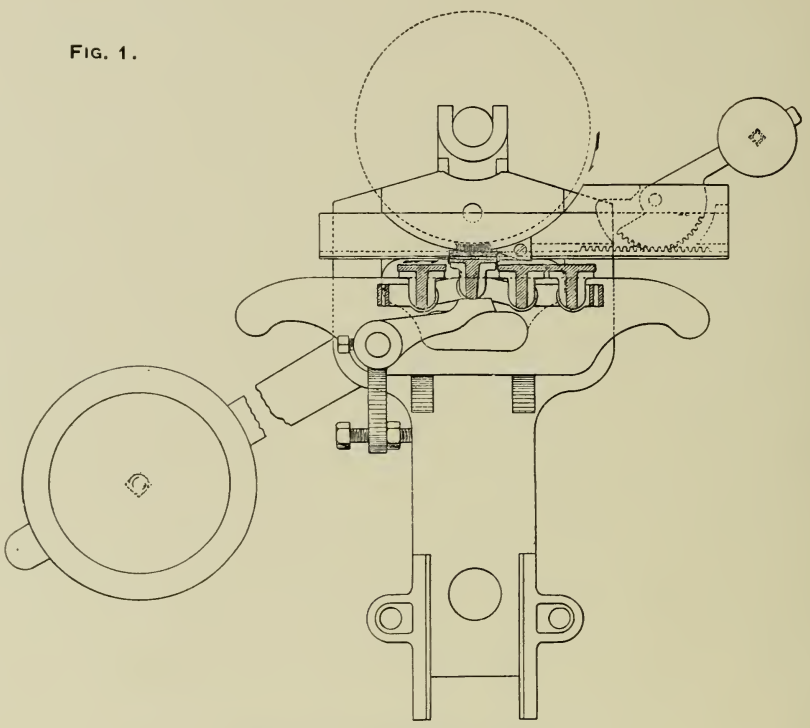
Flats:—40 inches long by $\frac{7}{8}$ inch width of points, about 40 square feet clothing.

Belting:—For doffer, 14 feet 2 inches of 2 inch belt; for licker-in 9 feet of 2 inch belt; for top flats, 6 feet of $1\frac{1}{2}$ inch belt; for comb (2 belts), 8 feet 9 inches and 7 feet 9 inches of round belt $\frac{3}{8}$ inch diameter; for brush, 5 feet 1 inch of round belt $\frac{3}{8}$ inch diameter.

No allowance in above for lapping.

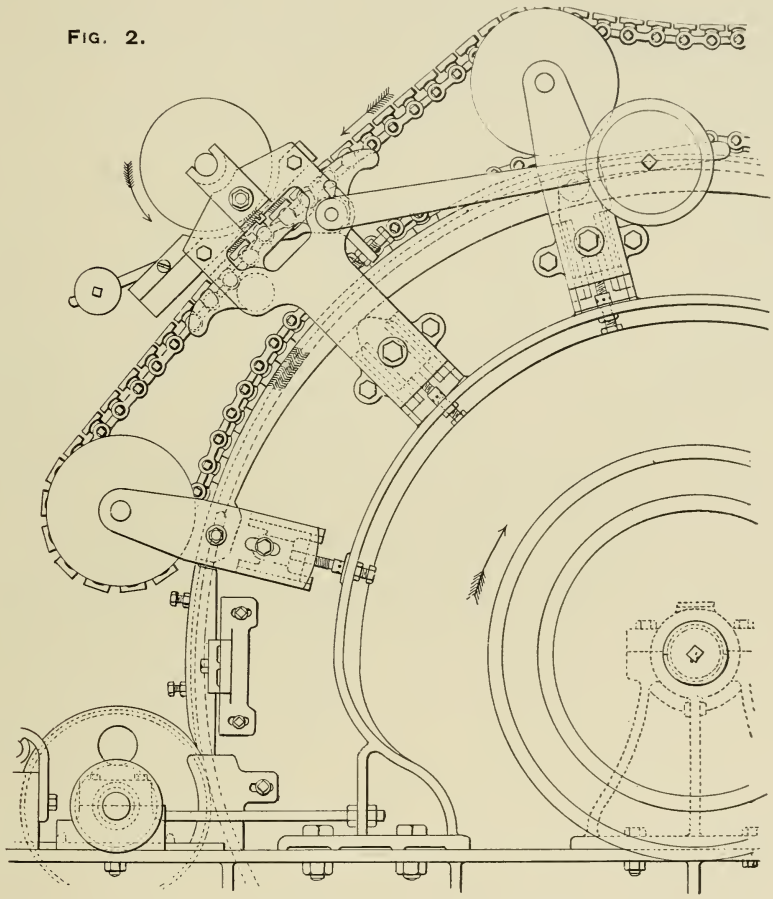
Floor Space:—Outside 18 inch lap and 10 inch coiler, 10 feet 3 inches by 5 feet, $5\frac{1}{4}$ inches over all.

FIG. 1.



IMPROVED GRINDING DEVICE.

FIG. 2.



IMPROVED GRINDING DEVICE.

Improved Grinding Device

For Revolving Flats of Carding Engine.

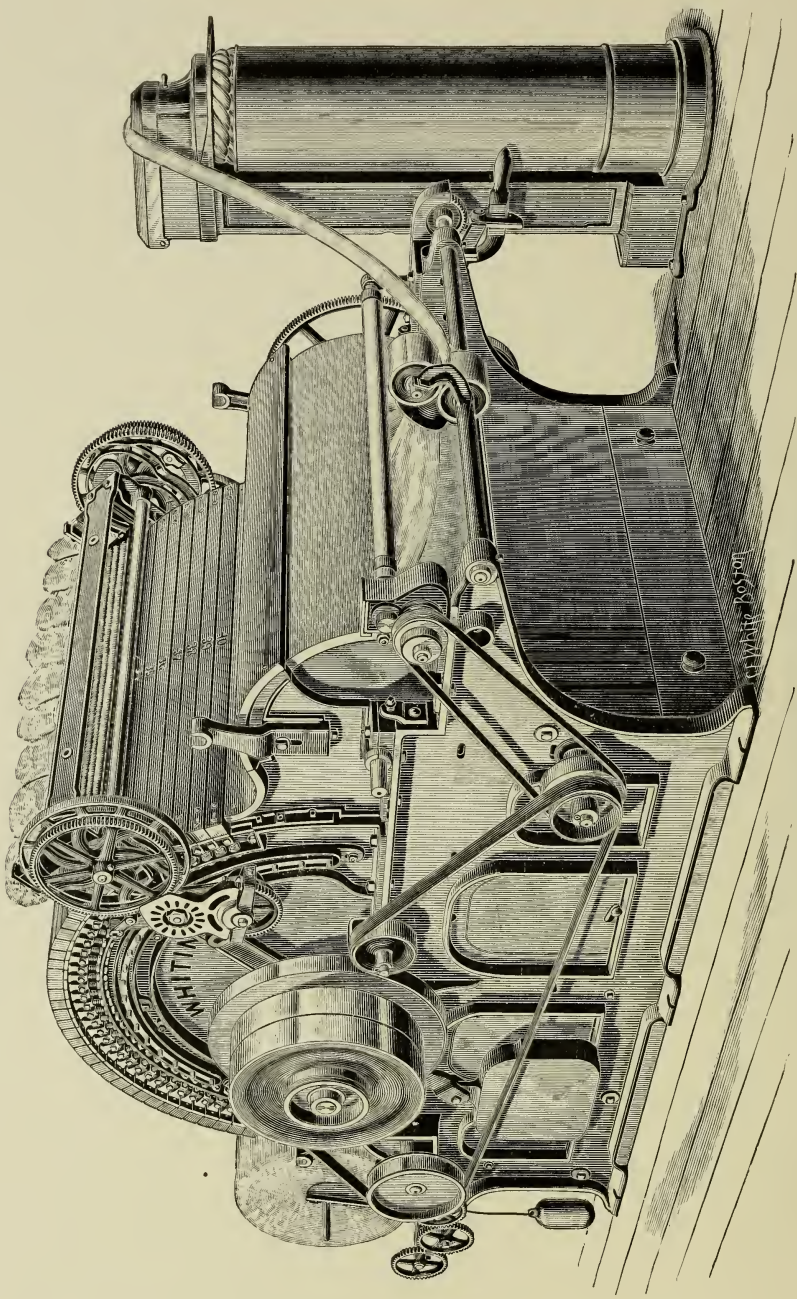
We consider the grinding device herewith shown the simplest and most reliable in use for perfect grinding of the top flats. The grinding surface, in distinction to the carding surface, of the flats, is done away with, both operations being performed from the same face. Under the old system of carding from one surface and grinding from another, both faces of the flat became worn, and the original form was finally destroyed, thus making it impossible to set the flats accurately enough for the best results. The device we apply removes this objection, as there is only one surface subjected to wear. The flats are supported on the same face and in the same plane when grinding as when carding, consequently the original pitch is maintained, and the flats in position on the flexible bend can all be set by the same guage to the cylinder.

The device will be easily understood by reference to Fig. 1. At the top will be seen the bridge bracket in which a rack and bar slide. To this bar is attached a shoe or pin (shown across the end of the raised flat) the lower surface of which is milled to the particular bevel at which it is desired to grind the flat. The position of the carding surfaces of the flats when grinding is regulated by the shoe or pin, and the action of the lifter (shown as supporting the raised flat) with its levers, one of which is loaded by the large weight at the left. Each flat as it travels along seizes the lip of the shoe, and is carried along until the clothed surface has passed under the grinding roller. The flat then drops off the lifter, and releases the shoe, which is immediately returned to its original position by the positive movement of the rack, quadrant, and small weight at the right. Should the flat not leave the shoe at the right instant, it will be carried against the fixed incline or stop (shown at the right of the raised flat), when the flat will release the shoe positively. It will be seen that each flat is treated alike, ensuring uniformity in grinding that can not be surpassed.

Fig. 2. shows the device in position on the card. It may be placed at the back or front, the former position being generally preferred on account of convenience in setting the grinding roller.

Extras Required.

STRIPPING ROLL, for brushing out cylinder and doffer.
BURNISHING ROLL for burnishing clothing.
LONG ROLL GRINDER for grinding flats.
TWO TRAVERSE GRINDERS for grinding cylinder and doffer.



IMPROVED LICKER-IN CARD.

Improved Licker-in Card,

—— WITH ——

42 in. Diameter Cylinder and Iron Top Flats.

This machine will produce one hundred pounds and upwards per day of fine carding, with the minimum amount of waste. The sides and arches of the card are built entirely of iron, and the construction is simple so that changes can be readily made. The main cylinder is 42 inches, and the doffer 18 inches in diameter, measured without the clothing. Both are accurately ground, and are balanced to a speed largely in excess of that used in practice. The cylinder is clothed close up to either edge, securing a carding surface $37\frac{1}{4}$ inches wide. The clothed surface of the doffer is slightly in excess of this. The card is provided with forty iron flats, the arc described by these being greater than formerly, and equal to fully two-fifths of the circumference of the cylinder. The flats are now made $1\frac{3}{8}$ inches wide, with clothed surface of $\frac{13}{16}$ of an inch. They are planed and ground perfectly true to receive the clothing, and being heavily ribbed are free from the possibility of warping or twisting. The ends of the flats are also planed, and thus their correct pitch with the surface of the cylinder is accurately and uniformly obtained. The device for adjusting the flats consists of a square steel body, terminating at either end in a pin. The lower pin, having a fine thread cut upon it, passes through a rib in the card arch, and is secured on both sides of the rib by a nut. Thus any flat may be accurately and quickly adjusted. Mortises, accurately spaced, and planed into a second rib on the card arch, receive the square bodies of the adjusting pins thus preventing any lateral motion. The adjusting pin is further secured by a screw passing through the square body into the arch. The top flat passes over the upper part of the adjusting pin, and find a true bearing on a small collar turned upon the upper side of the body of the pin. We claim for this device great ease and nicety of adjustment, and perfect immovability when set.

We recommend for use with this card, our Improved Quick Stripper. This lifts, strips and replaces a flat in less than four seconds. It is also variable in its action, so that the flats nearest the feed rolls may be stripped oftener than those near the doffer. The stripper is geared at both sides of the card, thus securing entire freedom from tortion. Each arm is moved positively and accurately to its place, and is held immovable while stripping is accomplished. The common Wellman Stripper may be applied when desired.

The card is fitted with a screen under the cylinder, to check

draughts, and to reduce waste from fly off cylinder. Also, with escutcheons at the rims of cylinders, which prevent "balling out." All parts are carefully cased in, and hinged covers are placed wherever convenience requires.

Our new Quick Running Comb is applied and may be run as high as fourteen hundred strokes a minute.

Our improved coiler may be used with this card, or the sliver may be carried to railway heads by the usual system of troughs.

The card is fitted with a simple and sure device whereby feed may be instantly stopped and also the doffer thrown out of gear with coiler and calender rolls. Thus either doffer or cylinder may be revolved for stripping, and be kept perfectly isolated from the rest of the card mechanism.

This card is finely finished throughout, and is built in the most substantial manner. It will commend itself to all desiring an engine of large capacity for fine work, and yet so simple in construction as to be easily adjusted and cared for.

FEED ROLLS:—Shell feed and burr roll $1\frac{1}{2}$ in. diameter.

DRIVING PULLEYS:—3 in. face, 16 in. diameter.

CLOTHING:—Cylinder 42 in. diameter, carding surface $37\frac{1}{4}$ in. wide.

DOFFER:—18 in. diameter, carding surface $37\frac{3}{8}$ in. wide.

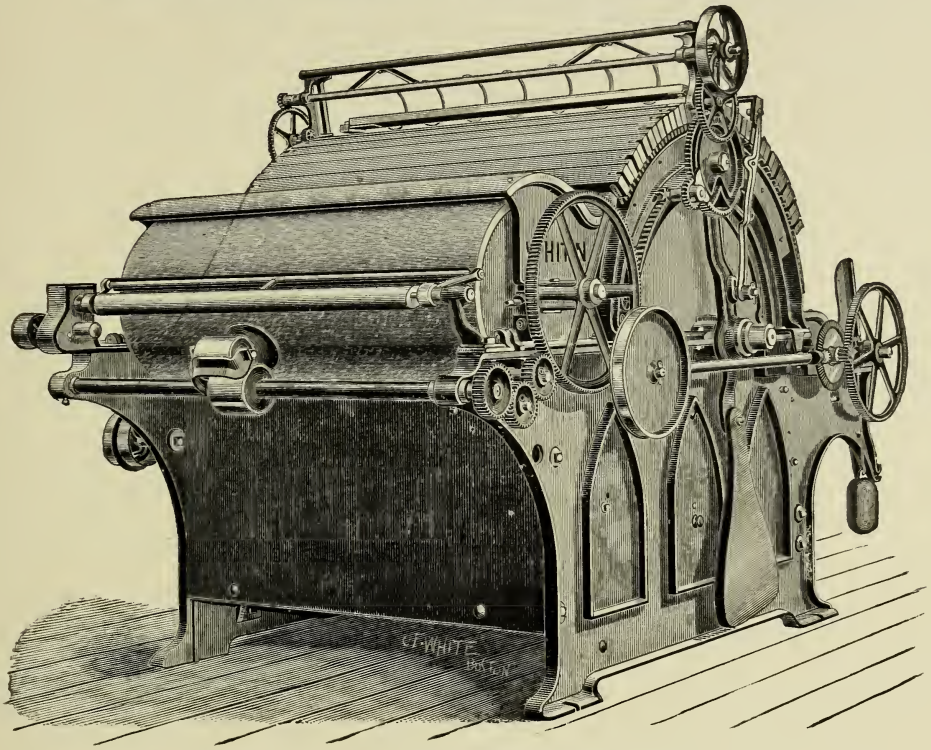
FLATS:—$37\frac{1}{4}$ in. $\times$ $\frac{13}{16}$ in. width of points.

FLOOR SPACE:—Outside coiler, 9 ft. 6 in. $\times$ 5 ft. 6 in.; without coiler 8 ft. 2 in. $\times$ 5 ft. 2 in.

BELTING:—For licker-in 12 ft. 3 in. of $1\frac{3}{4}$ in. belt; for side shaft 7 ft. 6 in. of $1\frac{1}{4}$ in. belt; for stripper and comb 9 ft. 5 in. of 1 in. belt.

No allowance is made above for lapping.

Top Flat Card
— WITH —
Licker-in and Wellman Stripper.



This machine is built with shell feed, screens under cylinder and escutcheons over the ends of cylinder. By these means the air currents are controlled, and the annoyance of "balling out" at the doffer is wholly obviated. The machine is capable of doing a large quantity of first class work suitable for yarns as fine as 40's. It is conveniently arranged for making changes, and is easily taken care of. It may be fitted with either the Wellman or Whitin improved quick stripper. The latter is variable in its action, stripping the top flats in any order desired.

Driving Pulleys are 14 in. diameter, $2\frac{1}{2}$ in. face, 128 revolutions per minute.

Clothing for 36 in. wide Card : — Main cylinder 36 in. diameter, prepared for twenty-two sheets, 4 in. × 37 in. No. 32 wire. One doffer, $15\frac{1}{8}$ in. dia. × 37 in., No 33 wire. One licker-in, 7 in. dia. × 37 in., diamond point wire. Nineteen top-flats, 19 sheets, $1\frac{1}{4}$ × 37 in No. 32 wire. One stripper sheet, 5 in. wide, teeth set $2\frac{3}{4}$ × 37 in., No. 32 wire ; on back, 1 in. from edge.

Feed Rolls : — Cards 36 in. wide have $1\frac{3}{8}$ in. diameter rolls. Shell feed, with $1\frac{1}{2}$ in. burr rolls may also be applied.

Tables : — See Table of Production, and also the Change Draught Gear Table.

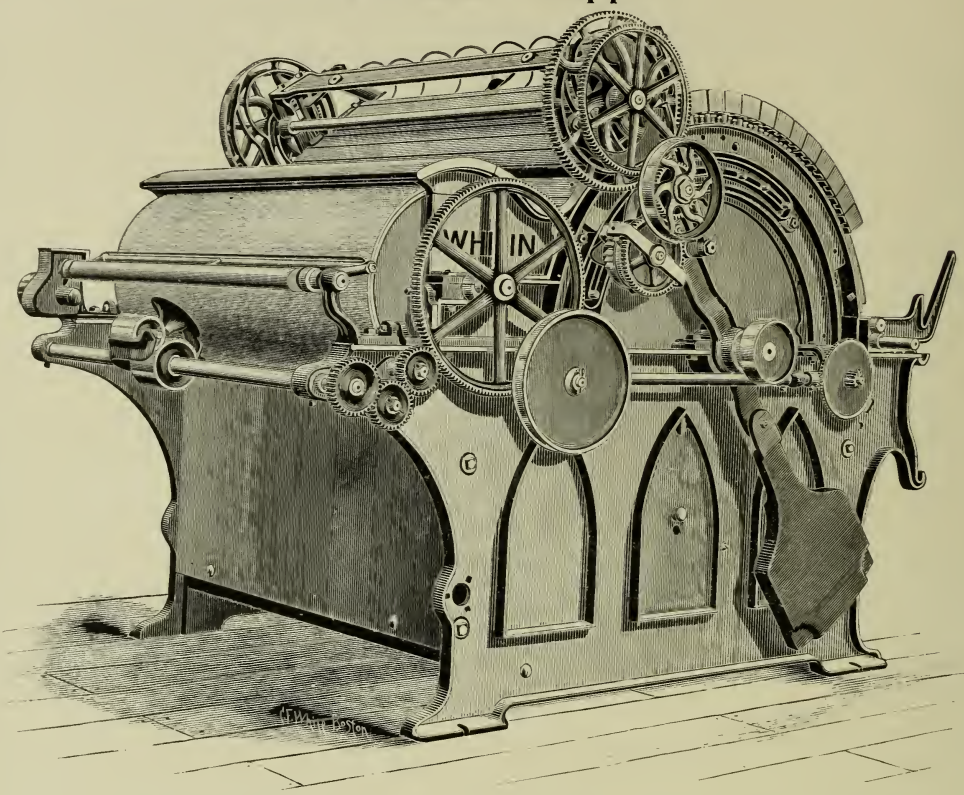
Floor Space : — From outside full lap to outside 10 in. trough, about 7 ft. 9 in., and 4 ft. 9 in. wide.

Belting Required : — For licker-in and double comb pulley, 10 ft. 7 in., of $1\frac{1}{2}$ in. belt ; for comb and stripper, 8 ft. $11\frac{1}{2}$ in., of 1 in. belt. No allowance made above for lapping.

Improved Top Flat Card

— WITH —

Variable Top Flat Stripper, made also with Wellman Stripper.



This machine is similar to the common Top card, the principal difference being in the stripping mechanism. It is arranged, (without complication) so that the flats nearest the feed rolls may be stripped oftener than those nearest the doffer. In this way the first six may be stripped three times: the second six, two times: the third six, or those nearest the doffer, once in a given time. Another advantage is, a Top card is taken up, stripped and replaced in position in less than four seconds, instead of forty seconds, as with the Wellman stripper.

Driving Pulleys are 14 and 16 in. dia., 2 and $2\frac{1}{2}$ in. face, 128 rev. per minute.

Clothing for 36 in. Cards: — One main cylinder 36 in. diameter, prepared for 22 sheets, 4 × 37 in., No. 32 wire: one doffer $15\frac{1}{8}$ in. diameter, 37 in. long, No. 33 wire. Eighteen top flats require 18 sheets $1\frac{1}{4}$ × 37 in., No. 32 wire. One stripper sheet 5 in. wide, teeth set $2\frac{3}{4}$ × 37 in., No. 32 wire; on the back, 1 in. from the edge.

Feed Rolls: — Cards 36 in. wide have $1\frac{3}{8}$ in. diameter rolls. Also, fitted with shell feed and $1\frac{1}{2}$ in. burr roll.

Tables: — See Tables for Production, and also Change Draught Gear Tables.

Floor Space: — From outside of full lap to outside of 10 in. trough, about 7 ft. 9 in.; and width outside pulleys, etc., 4 ft. 9 in.

Belting Required: — For stripper, 4 ft. 4 in. of 1 in. belt; for comb, 10 ft. 1 in. of $1\frac{1}{2}$ in. belt. No allowance is made for lapping.

Full Roller, Combination, and Arlington Top Flat Cards.

We are still prepared to build Cards of the above types, for customers desiring to match systems already in the mill, or the nature of whose work advise their use.

DECIMAL EQUIVALENTS.

Ounces.	Grains.	Ounces.	Grains.
1	= 437.5	11	= 4812.5
2	= 875.	11½	= 5031.25
3	= 1312.5	12	= 5250.
4	= 1750.	12½	= 5468.75
5	= 2187.5	13	= 5687.5
6	= 2625.	13½	= 5906.25
7	= 3062.5	14	= 6125.
8	= 3500.	14½	= 6343.75
9	= 3937.5	15	= 6562.5
10	= 4375.	15½	= 6781.25
10½	= 4593.75	16	= 7000.

CARD CLOTHING.

English Counts.	Points per Square Foot.	American Number of Wire
60's	43200	28
70's	50400	30
80's	57600	31
90's	64800	32
100's	72000	33
110's	79200	34
120's	86400	35
130's	93600	36

For Coarse Yarns use on { Cylinders, Nos. 90's and 100's. / Doffers and Flats, Nos. 100's and 110's.

For Medium Yarns use on { Cylinders, Nos. 100's and 110's. / Doffers and Flats, Nos. 110's and 120's.

FILLET FOR CYLINDERS AND DOFFERS.

WITH 4 CROWNS, OR 24 POINTS PER INCH.

Noggs per Inch.	Points per Square Foot.	American Number of Wire
16	55296	31
17	58752	
18	62208	32
19	65664	
20	69120	33
21	72576	
22	76032	34
23	79488	
24	82944	35
25	86400	
26	89856	36

SHEETS FOR TOP FLATS.

Points per Inch in Length.	POINTS PER INCH IN WIDTH.					
	25	24	23	22	21	20
	Points per Sq. Ft.	Points per Sq. Ft.	Points per Sq. Ft.	Points per Sq. Ft.	Points per Sq. Ft.	Points per Sq. Ft.
25	90000	86400	82800	79200	75600	72000
24	86400	82944	79488	76032	72576	69120
23	82800	79488	76176	72864	69552	66240
22	79200	76032	72864	69696	66528	63360
21	75600	72576	69552	66528	63504	60480
20	72000	69120	66240	63360	60480	57600

Draught Table of Revolving Flat Card.

Diameter of { Feed Roll, $2\frac{1}{4}$ inches, Coiler Calender Rolls, 2 inches,

Feed Roll Gear, 160 Teeth, Doffer Gear, 192 Teeth,

Card Calender Roll Shaft Gear, 28 Teeth.

Driver, Coiler Shaft Gear, 36 Teeth.

Coiler Shaft Gear, 18 Teeth.

15	Teeth	Change	Gear.	130.00	Draught.
16	"	"	"	121.90	"
17	"	"	"	114.73	"
18	"	"	"	108.36	"
19	"	"	"	102.65	"
20	"	"	"	97.52	"
21	"	"	"	92.88	"
22	"	"	"	88.65	"
23	"	"	"	84.80	"
24	"	"	"	81.27	"
25	"	"	"	78.02	"
26	"	"	"	75.01	"
27	"	"	"	72.23	"
28	"	"	"	69.66	"
29	"	"	"	67.25	"
30	"	"	"	65.01	"
31	"	"	"	62.91	"

Table of Draughts of The Whitin Cards

of the following kinds, viz.:

Improved Licker-in, with 42 in. Cylinder and Iron Top Flats.
Improved Top Flat, with Variable Stripper.
The Licker-in Top Flat, with Wellman Stripper,
The Whitin Patent Combination, with Wellman Stripper,
The Whitin (New Model) Full Roller Card.

15 INCHES AND 18 INCHES DOFFERS.

DRAUGHT BETWEEN 1⅜ INCHES FEED ROLL AND 3⅞ INCHES CALENDER ROLL.

Spur Pinion.	Bevel Pinion.	Bevel Gear.	Draught.	Spur Pinion.	Bevel Pinion.	Bevel Gear.	Draught.	Spur Pinion.	Bevel Pinion.	Bevel Gear.	Draught.
10 T	10 T	67	112.43	12 T	12 T	69	80.41	14 T	14 T	93	79.62
10	10	69	115.79	12	12	93	108.38	14	15	67	53.54
10	10	93	156.06	12	13	67	72.07	14	15	69	55.14
10	11	67	102.21	12	13	69	74.22	14	15	93	74.32
10	11	69	105.26	12	13	93	100.04	14	16	67	50.20
10	11	93	141.88	12	14	67	66.92	14	16	69	51.69
10	12	67	93.70	12	14	69	68.92	14	16	93	69.67
10	12	69	96.49	12	14	93	92.90	15	10	67	74.95
10	12	93	130.05	12	15	67	62.46	15	10	69	77.19
10	13	67	86.48	12	15	69	64.33	15	10	93	104.04
10	13	69	89.07	12	15	93	86.70	15	11	67	68.14
10	13	93	120.05	12	16	67	58.56	15	11	69	70.17
10	14	67	80.31	12	16	69	60.31	15	11	93	94.58
10	14	69	82.70	12	16	93	81.28	15	12	67	62.46
10	14	93	111.47	13	10	67	86.48	15	12	69	64.33
10	15	67	74.95	13	10	69	89.07	15	12	93	86.70
10	15	69	77.19	13	10	93	120.05	15	13	67	57.65
10	15	93	104.04	13	11	67	78.62	15	13	69	59.34
10	16	67	70.27	13	11	69	80.97	15	13	93	80.03
10	16	69	72.37	13	11	93	109.14	15	14	67	53.54
10	16	93	97.54	13	12	67	72.07	15	14	69	55.14
11	10	67	102.21	13	12	69	74.22	15	14	93	74.32
11	10	69	105.26	13	12	93	100.04	15	15	67	49.97
11	10	93	141.88	13	13	67	66.52	15	15	69	51.46
11	11	67	92.91	13	13	69	68.51	15	15	93	69.36
11	11	69	95.69	13	13	93	92.35	15	16	67	46.85
11	11	93	128.98	13	14	67	61.78	15	16	69	48.25
11	12	67	85.17	13	14	69	63.62	15	16	93	65.03
11	12	69	87.72	13	14	93	85.75	16	10	67	70.27
11	12	93	118.23	13	15	67	57.65	16	10	69	72.37
11	13	67	78.62	13	15	69	59.34	16	10	93	97.54
11	13	69	80.97	13	15	93	80.03	16	11	67	63.88
11	13	93	109.14	13	16	67	54.05	16	11	69	65.79
11	14	67	73.01	13	16	69	55.67	16	11	93	88.67
11	14	69	75.19	13	16	93	75.03	16	12	67	58.56
11	14	93	101.34	14	10	67	80.31	16	12	69	60.31
11	15	67	68.14	14	10	69	82.70	16	12	93	81.28
11	15	69	70.17	14	10	93	111.47	16	13	67	54.05
11	15	93	94.58	14	11	67	73.01	16	13	69	55.67
11	16	67	63.88	14	11	69	75.19	16	13	93	75.03
11	16	69	65.78	14	11	93	101.34	16	14	67	50.20
11	16	93	88.67	14	12	67	66.92	16	14	69	51.69
12	10	67	93.70	14	12	69	68.92	16	14	93	69.67
12	10	69	96.49	14	12	93	92.90	16	15	67	46.85
12	10	93	130.05	14	13	67	61.78	16	15	69	48.25
12	11	67	85.17	14	13	69	63.62	16	15	93	65.03
12	11	69	87.72	14	13	93	85.75	16	16	67	43.92
12	11	93	118.23	14	14	67	57.36	16	16	69	45.23
12	12	67	78.08	14	14	69	59.08	16	16	93	60.96

REVOLVING FLAT CARD.

Cylinder 165 rev. Cyl. Pul'y 18" dia. Licker-in Driven 7" dia. Licker-in Driver 4½" dia.

Table showing the number pounds Card Sliver produced in one day of 10 hours.

DOFFER 24¾ INCHES DIAMETER OUTSIDE OF CLOTHING.

NUMBER OF GRAINS IN ONE YARD SLIVER.

Side Pul'y 15½" dia. Doffer Gear 192 T

Change Gear.	Rev. of Doffer per Minute	40 LBS.	42 LBS.	44 LBS.	46 LBS.	48 LBS.	50 LBS.	52 LBS.	54 LBS.	56 LBS.	58 LBS.	60 LBS.	62 LBS.	64 LBS.	66 LBS.	68 LBS.	70 LBS.	72 LBS.	74 LBS.	76 LBS.	Rev. of Doffer per Minute
14 T	8.48	59.60	62.58	65.56	68.54	71.52	74.50	77.48	80.46	83.44	86.42	89.40	92.38	95.36	98.34	101.32	104.30	107.28	110.26	113.24	8.48
15	9.09	64.00	67.20	70.40	73.60	76.80	80.00	83.20	86.40	89.60	92.80	96.00	99.20	102.40	105.60	108.80	112.00	115.20	118.40	121.60	9.09
16	9.70	68.40	71.82	75.24	78.66	82.08	85.50	88.92	92.34	95.76	99.18	102.60	106.02	109.44	112.86	116.28	119.70	123.12	126.54	129.96	9.70
17	10.30	72.40	76.02	79.64	83.26	86.88	90.50	94.12	97.74	101.36	104.98	108.60	112.22	115.84	119.46	123.08	126.70	130.32	133.94	137.56	10.30
18	10.91	76.80	80.64	84.48	88.32	92.16	96.00	99.84	103.68	107.52	111.36	115.20	119.04	122.88	126.72	130.56	134.40	138.24	142.08	145.92	10.91
19	11.52	81.20	85.26	89.32	93.38	97.44	101.50	105.56	109.62	113.68	117.74	121.80	125.86	129.92	133.98	138.04	142.10	146.16	150.22	154.28	11.52
20	12.12	85.60	89.88	94.16	98.44	102.72	107.00	111.28	115.56	119.84	124.12	128.40	132.68	136.96	141.24	145.52	149.80	154.08	158.36	162.64	12.12
21	12.73	89.60	94.08	98.56	103.04	107.52	112.00	116.48	120.96	125.44	129.92	134.40	138.88	143.36	147.84	152.32	156.80	161.28	165.76	170.24	12.73
22	13.34	94.00	98.70	103.40	108.10	112.80	117.50	122.20	126.90	131.60	136.30	141.00	145.70	150.40	155.10	159.80	164.50	169.20	173.90	178.60	13.34
23	13.94	98.40	103.32	108.24	113.16	118.08	123.00	127.92	132.84	137.76	142.68	147.60	152.52	157.44	162.36	167.28	172.20	177.12	182.04	186.96	13.94
24	14.55	102.40	107.52	112.64	117.76	122.88	128.00	133.12	138.24	143.36	148.48	153.60	158.72	163.84	168.96	174.08	179.20	184.32	189.44	194.56	14.55
25	15.15	106.80	112.14	117.48	122.82	128.16	133.50	138.84	144.18	149.52	154.86	160.20	165.54	170.88	176.22	181.56	186.90	192.24	197.58	202.92	15.15
26	15.76	111.20	116.76	122.32	127.88	133.44	139.00	144.56	150.12	155.68	161.24	166.80	172.36	177.92	183.84	189.04	194.60	200.16	205.72	211.28	15.76
27	16.37	115.60	121.38	127.16	132.94	138.72	144.50	150.78	156.06	161.84	167.62	173.40	179.18	184.96	190.74	196.52	202.30	208.08	213.86	219.64	16.37
28	16.97	119.60	125.58	131.56	137.54	143.52	149.50	155.48	161.46	167.44	173.42	179.40	185.38	191.36	197.34	203.32	209.30	215.28	221.26	227.24	16.97
29	17.58	124.00	130.20	136.40	142.60	148.80	155.00	161 20	167.40	173.60	179.80	186.00	192.20	198.40	204.60	210.80	217.00	223.20	229.40	235.60	17.58
30	18.18	128.00	134.40	140.80	147.20	153.60	160.00	166.40	172.80	179.20	185.60	192.00	198.40	204.80	211.20	217.60	224.00	230.40	236.80	243.20	18.18
31	18.79	132.40	139.02	145.64	152.26	158.88	165.50	172.12	178.74	185.36	191.98	198.60	205.22	211.84	218.46	225.08	231.70	238.32	244.94	251.56	18.79
32	19.40	136.80	143.64	150.48	157.32	164.16	171.00	177.84	184.68	191.52	198.36	205.20	212.04	218.88	225.72	232.56	239.40	246.24	253.08	259.92	19.40
33	20.00	140.80	147.84	154.88	161.92	168.96	176.00	183.04	190.08	197.13	204.16	211.20	218.24	225.28	232.32	239.36	246.40	253.44	260.48	267.52	20.00

NOTE.—In the above table 5% of the time is allowed for cleaning, stripping, etc.

THE WHITIN CARD.

Tables showing the number pounds, Avoirdupois, of Card Sliver produced in one day of 10 hours.

Rev. per Min.	Doffer 18¾ in. Diameter Outside the Clothing. Number of grains in one yard of sliver.																				Rev. per Min.
	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	70	
	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	
6	22.73	24.24	25.76	27.27	28.79	30.31	31.82	33.34	34.85	36.37	37.88	39.40	40.91	42.43	43.94	45.46	46.97	48.49	50.00	53.03	6
6½	24.62	26.26	27.91	29.55	31.19	32.83	34.47	36.11	37.76	39.40	41.04	42.68	44.32	45.96	47.60	49.25	50.89	52.53	54.17	57.45	6½
7	26.52	28.28	30.05	31.82	33.59	35.36	37.12	38.89	40.66	42.43	44.20	45.96	47.73	49.50	51.27	53.03	54.80	56.57	58.34	61.87	7
7½	28.41	30.30	32.20	34.09	35.99	37.88	39.78	41.67	43.56	45.46	47.35	49.25	51.14	53.03	54.93	56.82	58.72	60.61	62.51	66.29	7½
8	30.31	32.33	34.35	36.37	38.39	40.41	42.43	44.45	46.47	48.49	50.51	52.53	54.55	56.57	58.59	60.61	62.63	64.65	66.67	70.71	8
8½	32.20	34.35	36.49	38.64	40.79	42.93	45.08	47.23	49.37	51.52	53.67	55.81	57.96	60.11	62.25	64.40	66.55	68.69	70.84	75.13	8½
9	34.09	36.37	38.64	40.91	43.18	45.46	47.73	50.00	52.28	54.55	56.82	59.10	61.37	63.64	65.91	68.19	70.46	72.73	75.01	79.55	9
9½	35.99	38.39	40.79	43.19	45.58	47.98	50.38	52.78	55.18	57.58	59.98	62.38	64.78	67.18	69.58	71.98	74.37	76.77	79.17	83.97	9½
10	37.88	40.41	42.93	45.46	47.98	50.51	53.03	55.56	58.09	60.61	63.14	65.66	68.19	70.71	73.24	75.76	78.29	80.82	83.34	88.39	10
10½	39.78	42.43	45.08	47.73	50.38	53.03	55.69	58.34	60.99	63.64	66.29	68.94	71.60	74.25	76.90	79.55	82.20	84.86	87.51	92.81	10½
11	41.67	44.45	47.23	50.00	52.78	55.56	58.34	61.12	63.89	66.67	69.45	72.23	75.01	77.78	80.56	83.34	86.12	88.90	91.67	97.23	11
11½	43.56	46.47	49.37	52.28	55.18	58.09	60.99	63.89	66.80	69.70	72.61	75.51	78.42	81.32	84.22	87.13	90.03	92.94	95.84	101.65	11½
12	45.46	48.49	51.52	54.55	57.58	60.61	63.64	66.67	69.70	72.73	75.76	78.79	81.83	84.86	87.89	90.92	93.95	96.98	100.00	106.07	12
12½	47.35	50.51	53.67	56.82	59.98	63.14	66.29	69.45	72.61	75.76	78.92	82.08	85.24	88.39	91.55	94.71	97.86	101.02	104.18	110.49	12½
13	49.25	52.53	55.81	59.10	62.38	65.66	68.95	72.23	75.51	78.79	82.08	85.36	88.64	91.93	95.21	98.49	101.78	105.06	108.34	114.91	13
13½	51.14	54.55	57.96	61.37	64.78	68.19	71.60	75.01	78.42	81.83	85.23	88.64	92.05	95.46	98.87	102.28	105.69	109.10	112.51	119.33	13½
14	53.03	56.57	60.11	63.64	67.18	70.71	74.25	77.78	81.32	84.86	88.39	91.93	95.46	99.00	102.53	106.07	109.61	113.14	116.68	123.75	14
14½	54.93	58.59	62.25	65.91	69.58	73.24	76.90	80.56	84.22	87.89	91.55	95.21	98.87	102.53	106.20	109.86	113.52	117.18	120.84	128.17	14½
15	56.82	60.61	64.40	68.19	71.98	75.76	79.55	83.34	87.13	90.92	94.71	98.49	102.28	106.07	109.86	113.65	117.43	121.22	125.01	132.59	15
15½	58.72	62.63	66.55	70.46	74.38	78.29	82.20	86.12	90.03	93.95	97.86	101.78	105.69	109.61	113.52	117.43	121.35	125.26	129.18	137.01	15½
16	60.61	64.65	68.69	72.73	76.77	80.82	84.86	88.90	92.94	96.98	101.02	105.06	109.10	113.14	117.18	121.22	125.26	129.31	133.35	141.43	16

Note. — In the above tables, 10 per cent. of the time is allowed for oiling, cleaning, stripping, etc.

Tables showing the number of pounds Card Sliver produced in one day of 10 hours.

Rev. per Min.	Doffer 15¾ in. Diameter Outside the Clothing. Number of grains to one yard of sliver.																Rev. per Min.
	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	
4	10.60	12.72	14.84	16.96	19.08	21.20	23.32	25.44	27.56	29.68	31.80	33.92	36.04	38.16	40.28	42.40	4
4½	11.93	14.32	16.70	19.09	21.47	23.86	26.25	28.63	31.01	33.40	35.79	38.17	40.56	42.95	45.33	47.71	4½
5	13.25	15.90	18.55	21.20	23.85	26.50	29.15	31.80	34.45	37.10	39.75	42.40	45.05	47.70	50.35	53.01	5
5½	14.58	17.49	20.41	23.33	26.24	29.16	32.08	34.99	37.91	40.82	43.74	46.66	49.57	52.49	55.40	58.32	5½
6	15.90	19.08	22.26	25.44	28.62	31.80	34.98	38.16	41.34	44.52	47.70	50.88	54.06	57.24	60.42	63.62	6
6½	17.23	20.68	24.12	27.57	31.01	34.46	37.91	41.35	44.80	48.24	51.69	55.14	58.58	62.03	65.47	68.92	6½
7	18.56	22.27	25.98	29.70	33.41	37.12	40.83	44.54	48.26	51.96	55.68	59.39	63.10	66.82	70.53	74.22	7
7½	19.89	23.87	27.85	31.82	35.80	39.78	43.76	47.74	51.71	55.69	59.67	63.65	67.63	71.60	75.58	79.54	7½
8	21.21	25.45	29.69	33.94	38.18	42.42	46.64	50.88	55.12	59.36	63.63	67.84	72.08	76.32	80.56	84.84	8
8½	22.53	27.04	31.54	36.85	40.55	45.06	49.57	54.07	58.58	63.08	67.59	72.10	76.60	81.11	85.61	90.13	8½
9	23.86	28.63	33.40	38.18	42.95	47.72	52.49	57.26	62.04	66.81	71.58	76.35	81.12	85.90	90.67	95.44	9
9½	25.18	30.22	35.23	40.29	45.32	50.36	55.40	60.43	65.47	70.50	75.54	80.58	85.61	90.65	95.68	100.73	9½
10	26.51	31.81	37.11	42.42	47.72	53.02	58.32	63.62	68.93	74.23	79.53	84.83	90.13	95.44	100.74	106.00	10
10½	27.84	33.41	38.98	44.54	50.11	55.68	61.25	66.82	72.38	77.95	83.52	89.09	94.66	100.22	105.79	111.34	10½
11	29.16	35.02	40.82	46.66	52.49	58.32	64.15	69.98	75.82	81.65	87.48	93.31	99.14	104.98	110.81	116.63	11
11½	30.48	36.58	42.67	48.77	54.86	60.96	67.06	73.15	79.25	85.34	91.44	97.54	103.63	109.73	115.82	121.94	11½
12	31.81	38.17	44.51	50.88	57.26	63.62	69.96	76.32	82.68	89.04	95.43	101.76	108.15	114.48	120.84	127.23	12
12½	33.13	39.76	46.38	53.00	59.63	66.26	72.89	79.51	86.14	92.76	99.39	106.02	112.64	119.27	125.89	132.53	12½
13	34.46	41.36	48.26	55.14	62.05	68.92	75.83	82.73	89.62	96.52	103.41	110.30	117.20	124.09	130.98	137.84	13

Note: — In the above tables 10 per cent. of the time is allowed for cleaning, stripping, etc.

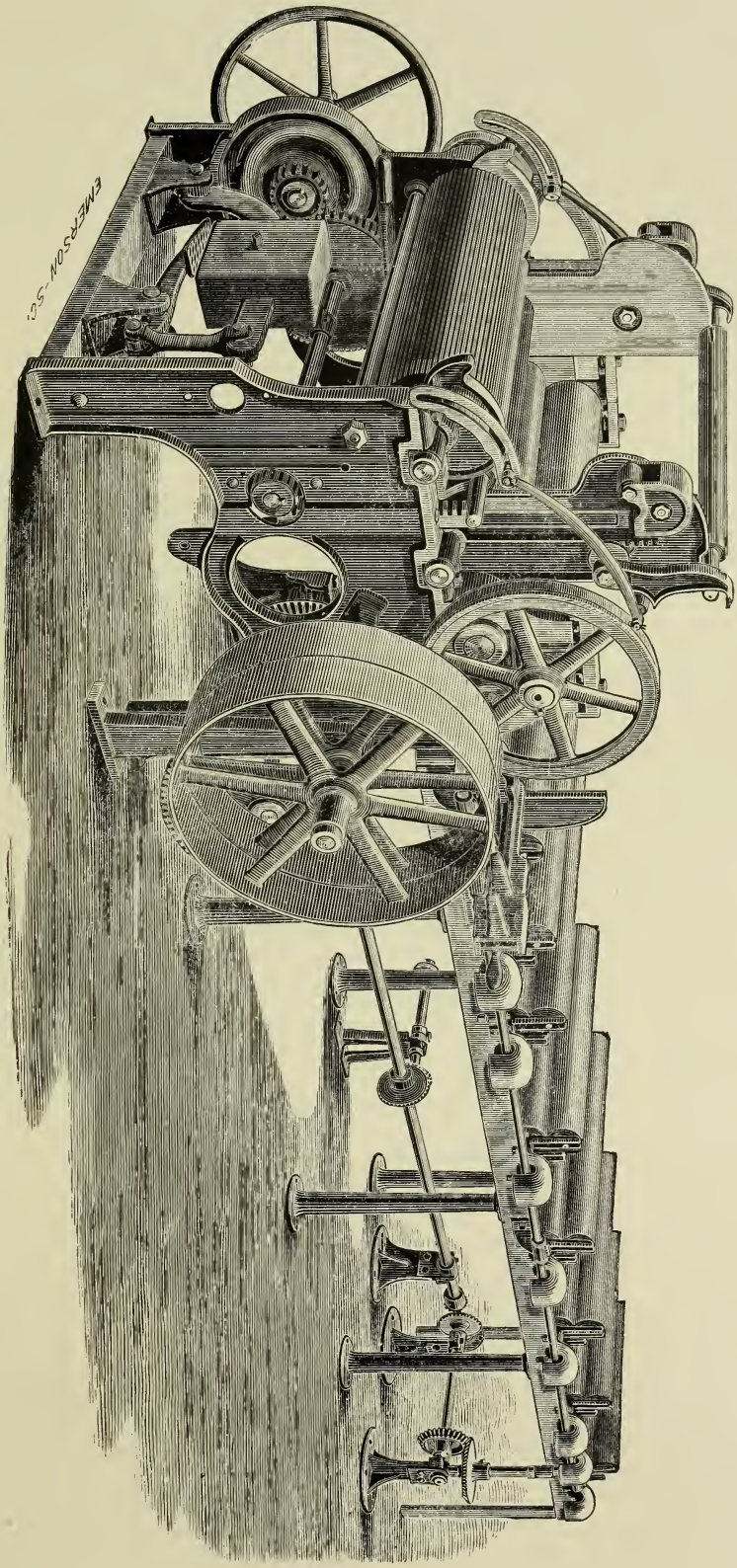
The Breaker Railway Head

is intended to be used where double carding is wanted, and the number of cards in Breaker section is not sufficient to make a full width of lap for Finisher cards. To this head is attached a drum $8\frac{1}{8}$ in. dia. for the Railway belt, and the sheet passes through or between 2 rolls at the top of the Head, and thence into rectangular sheet iron cans, nearly the width of the Railway trough inside, and 24 in. long. These cans sit on a carriage which traverses so as to lay the sheets evenly and compactly, and so as to deliver the cotton at the Lap-winder freely.

DRIVING PULLEYS:—$8\frac{1}{4}$ in. dia., 3 in. face, and run $25\frac{37}{100}$ rev. to one of $15\frac{3}{4}$ in. dia. doffer.

CANS:—May be 6, 8, 10, or 12 in. wide inside, 24 inches long, and 36 in. high.

FLOOR SPACE:—$4\frac{1}{2}$ feet long $\times$ 1 ft. 10 in. wide. Allow about 6 in. more in length for the outer traverse of the Can carriage.



LAP HEAD AND CARRYING FRAME.

Lap Head and Carrying Frame.

This machine is used when two systems of carding are required, and is arranged to make laps for Finisher cards from two or more lines of Breaker cards. It is provided with automatic lifting and measuring motion.

Laps for 36 in. cards weigh from 36 to 40 lbs. each.

DRIVING PULLEYS: — 24 in. dia., 4 in. face, $14\frac{82}{100}$ revolutions to one of $15\frac{3}{4}$ in. dia. doffer.

DRAUGHT: — Whole draught between doffer and lap rolls, $17\frac{13}{100}$ inches in 100.

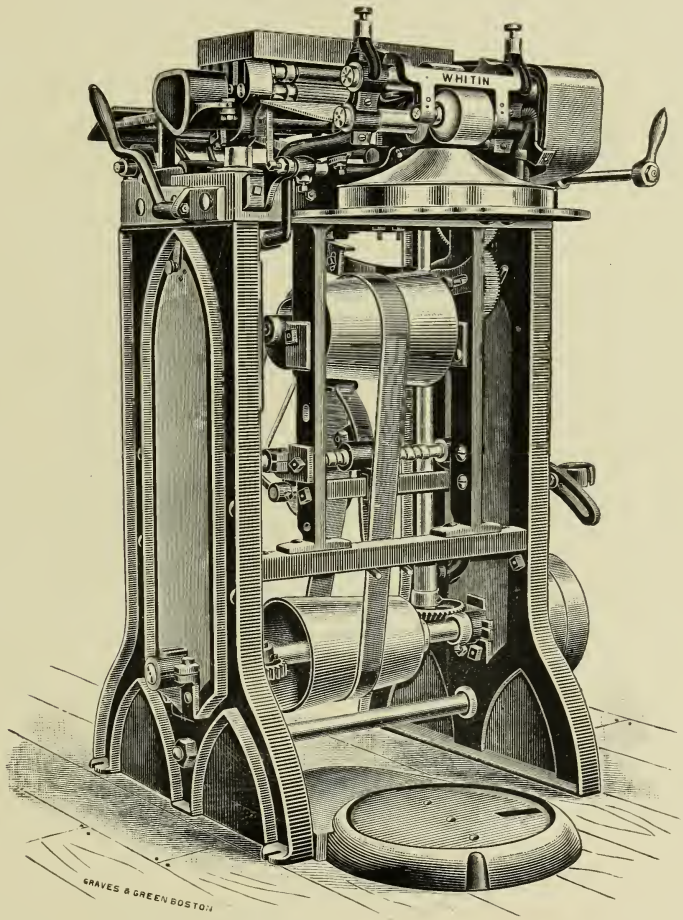
Without the Carrying Frame, the Lap Head is used to make laps by putting up four or more cans from the Breaker Railway Heads.

This machine makes laps for the Finisher cards from 36 to 40 lbs. weight.

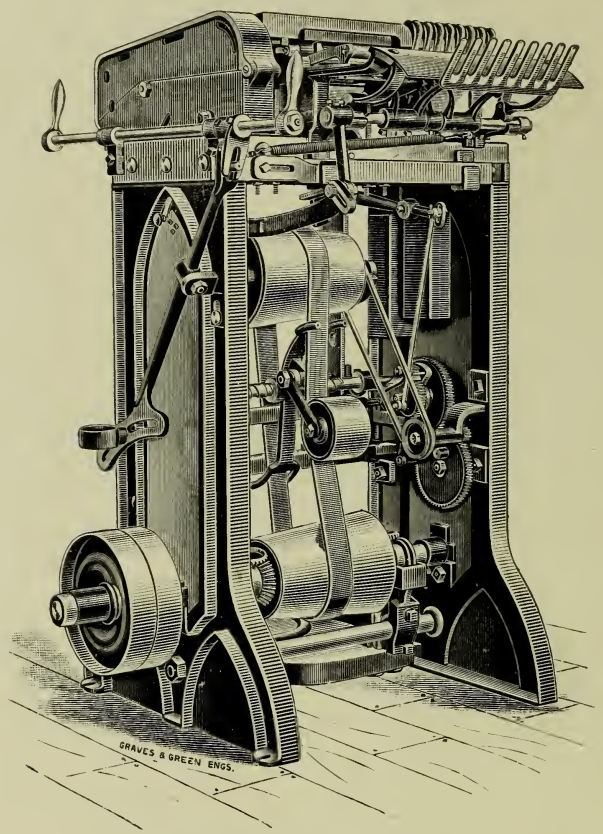
The Lap Head may be also arranged to double two laps into one.

DRIVING PULLEYS: — 24 in. dia., 4 in. face, 240 revolutions per minute.

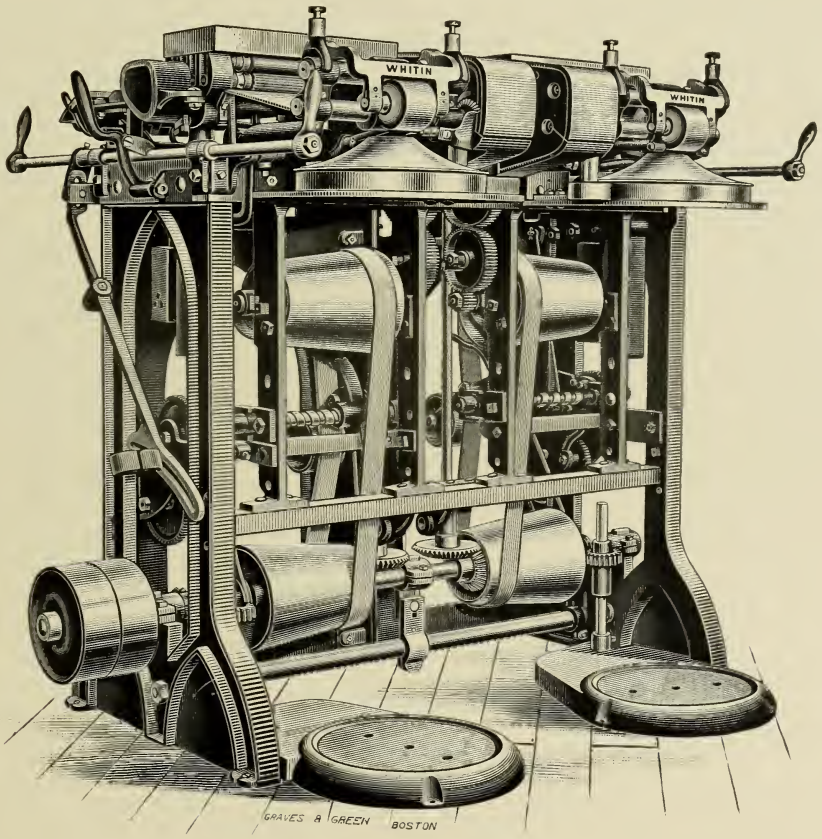
FLOOR SPACE: — Length, 5 ft. 2 in. outside cans. Width, 5 ft. 6 in. outside gears. pulleys, etc.



SINGLE RAILWAY HEAD (Front).



SINGLE RAILWAY HEAD (Back).



DOUBLE RAILWAY HEAD.

Coiler Railway Head.

Our new style head differs from the former pattern mainly in the fact that the table is now but two feet long instead of three, thus making it possible to place more heads in line across the card room. The heads can be run slower and better work be obtained. The improved coarse thread evener and binder pulley on cone belt is retained, the narrowing up of the head being accomplished almost entirely by re-arrangement of parts. The back rolls are now driven positively by an upright shaft instead of by a belt, thus avoiding slipping of belt and consequent breaking down of sliver. The head may be arranged for any number of doublings up to ten. A new and patented feature of this head consists of an auxiliary swinging calender roll, the purpose of which is to turn the sliver downward into the coiler trumpet. Thus the sliver is delivered evenly and smoothly into the coiler snout with no chance for doubling about, and the former necessity of threading the sliver through the coiler gear is avoided. The Coiler Railway Head is to be operated in connection with Cards, delivering into coiler cans, and takes the place of 1st process Drawing, giving an even sliver as the basis of subsequent operations. Heads are built in single deliveries, or two deliveries are placed on one four foot table, in which case both deliveries are driven with one main belt. The eveners, cones, etc. are entirely separate, however, so that in this respect each delivery works independently. The back and full can stop motions are similar in principle to those on our Drawing Frames, and will be found simple and reliable. The full can stop is operated by the pressure of the cotton in the can against the face plate of coiler, there being no gear to change when the weight of sliver is changed. Our patented front stop motion is effective and not likely to get out of order. The steel rolls are made with 8 inch boss. All gears are cut and are thoroughly protected with covers which can readily be set aside for cleaning, etc. Front steel roll $1\frac{3}{8}$ in. diam., back and middle rolls $1\frac{1}{8}$ in. diam. Leather covered shell front top roll; back and middle rolls solid unless otherwise ordered.

Driving Pulleys:—$8\frac{1}{4}$ in. to 16 in. diam., 2 in face.

Lengths of Tables:—Single Head 26 in. × 15 in., Double Heads 52 in. × 15 in.

Floor Space:—Single Head, outside feet and driving pulleys 3 ft. $1\frac{1}{2}$ in. × 3 ft. $7\frac{1}{2}$ in. from outside of apron to front side of coiler plate. Double Head, 5 ft. $3\frac{1}{2}$ in. × 3 ft. $7\frac{1}{2}$ in.

Can Tables:—For 10, 11, and 12 in. diam. cans.

The Finisher Railway, or Card Head

is built in single or double heads and is arranged for single, double, or triple lines of Railway troughs, each head being independent, and governing the feed and doffers of its respective section of cards. The Heads are made with rolls of 8 or 12 inch boss as desired, and when used with coiler cards are provided with sliver guides and back stop motions. Front stop motion also fitted when desired. The most approved evener, and binder pulley to prevent slipping of cone belt, is applied. All gearing is cut and is thoroughly protected with covers which can be conveniently set aside when cleaning, etc. The Heads may be set parallel with, or at right angles to the Railway troughs.

Driving Pulleys are $8\frac{1}{4}$ to 16 in. diameter, on lower cone shaft of Railway Head, and run about 48 revolutions to 1 of $15\frac{3}{4}$ in. diameter doffer (outside clothing).

Floor Room: — Single Head, outside feet and pulleys, 3 ft. 10 in. × 27 in. Double Head, 7 ft. 6 in. × 27 in.

Can Tables for 12, 14, 16, 18, 20 in. diameter cans.

Tables: — See Tables of Production, also Change Draught Gear Tables, which will be useful to those operating the machines.

Draught Table Finisher Railway Head.

Upright Shaft.

4 Rolls. Diameter of { Front Roll, $1\frac{3}{8}$ inches. Back Roll, $1\frac{1}{8}$ inches.

Back Roll Bevel Gear, 48 Teeth.

Upright Shaft. Top Bevel.	Front Roll Gear.	Change Pinion on Cone.	Draught.
14 Teeth.	24 Teeth.	14 Teeth.	3.585
14 "	24 "	15 "	3.841
14 "	24 "	16 "	4.097
14 "	24 "	17 "	4.354
14 "	24 "	18 "	4.610
14 "	24 "	19 "	4.867
14 "	24 "	20 "	5.123
14 "	24 "	21 "	5.380
14 "	24 "	22 "	5.635
14 "	24 "	23 "	5.891
14 "	24 "	24 "	6.147
14 "	24 "	25 "	6.403
14 "	24 "	26 "	6.659
14 "	24 "	27 "	6.915
14 "	24 "	28 "	7.171
14 "	24 "	29 "	7.428
14 "	24 "	30 "	7.684
14 "	24 "	31 "	7.940
14 "	24 "	32 "	8.196
14 "	24 "	33 "	8.452
14 "	24 "	34 "	8.708
14 "	24 "	35 "	8.964
14 "	24 "	36 "	9.220

Draught Table Finisher Railway Head.

Upright Shaft.

4 Rolls Diameter of { Front Roll, $1\frac{3}{8}$ inches. Back Roll, $1\frac{1}{8}$ inches.

Back Roll Bevel Gear, 55 Teeth.

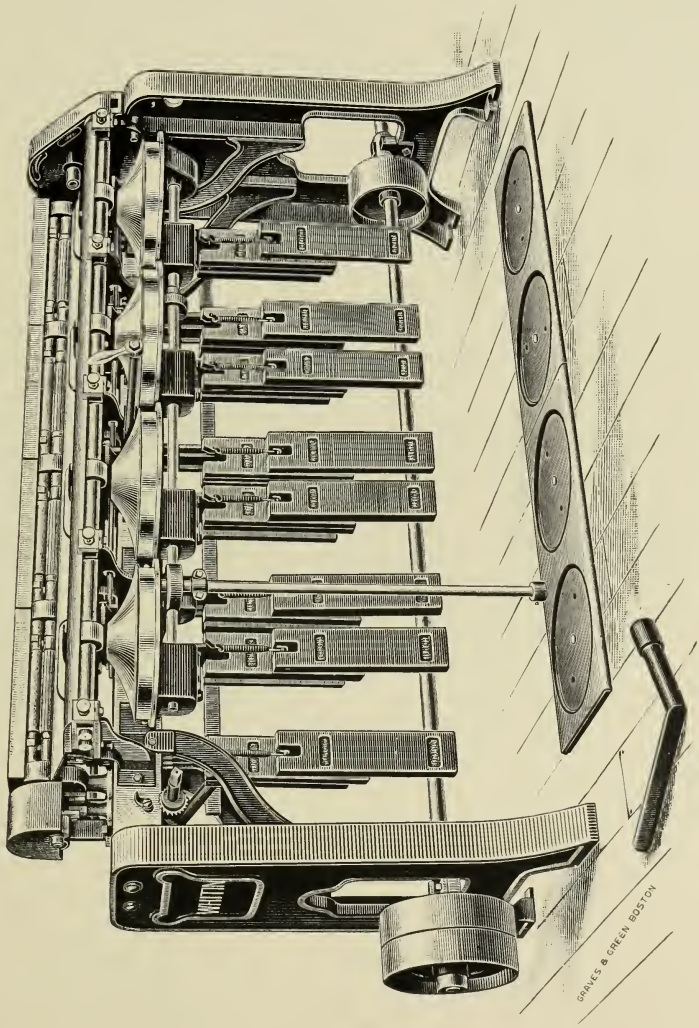
Upright Shaft. Top Bevel.	Front Roll. Gear.	Change Pinion on Cone.	Draught.
16 Teeth.	24 Teeth.	14 Teeth.	3.5938
16 "	24 "	15 "	3.8505
16 "	24 "	16 "	4.1072
16 "	24 "	17 "	4.3639
16 "	24 "	18 "	4.6206
16 "	24 "	19 "	4.8773
16 "	24 "	20 "	5.1340
16 "	24 "	21 "	5.3907
16 "	24 "	22 "	5.6474
16 "	24 "	23 "	5.9041
16 "	24 "	24 "	6.1608
16 "	24 "	25 "	6.4175
16 "	24 "	26 "	6.6742
16 "	24 "	27 "	6.9309
16 "	24 "	28 "	7.1876
16 "	24 "	29 "	7.4443
16 "	24 "	30 "	7.7010
16 "	24 "	31 "	7.9577
16 "	24 "	32 "	8.2144
16 "	24 "	33 "	8.4711
16 "	24 "	34 "	8.7278
16 "	24 "	35 "	8.9845
16 "	24 "	36 "	9.2412

THE WHITIN RAILWAY HEAD.

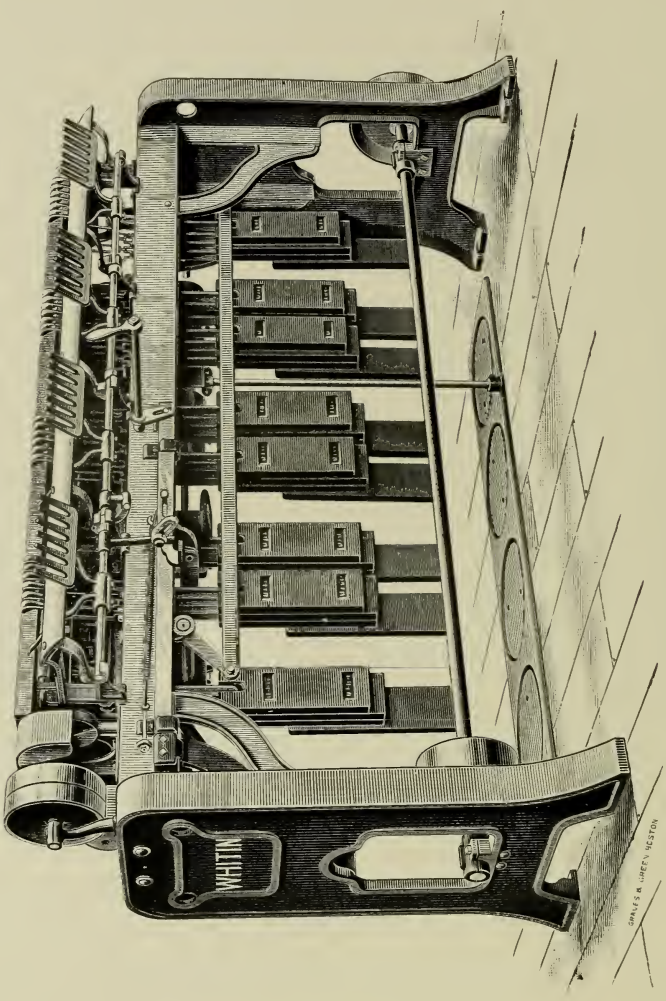
Table showing the number of pounds of Railway Sliver produced in one day of 10 hours.

Rev. of 1⅜ in. front roll per m.	NUMBER OF GRAINS TO ONE YARD OF SLIVER.											Rev. of 1⅜ in. front roll per m.
	50	60	70	80	90	100	110	120	130	140	150	
	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	
300	138.86	166.63	194.40	222.17	249.94	277.71	305.48	333.25	361.03	388.80	416.57	300
315	145.80	174.96	204.12	233.28	262.44	291.60	320.76	349.92	379.08	408.24	437.40	315
330	152.75	183.30	213.85	244.40	274.95	305.50	336.05	366.60	397.15	427.70	458.25	330
345	159.69	191.62	223.56	255.50	287.43	319.37	351.31	383.24	415.18	447.12	479.06	345
360	166.63	199.95	233.28	266.61	299.93	333.26	366.58	399.91	433.24	466.56	499.89	360
375	173.57	208.28	243.00	277.71	312.43	347.14	381.85	416.56	451.28	486.00	520.71	375
390	180.51	216.62	252.72	288.82	324.93	361.03	397.13	433.24	469.34	505.44	541.54	390
405	187.45	224.95	262.44	299.93	337.42	374.91	412.40	449.89	487.38	524.88	562.36	405
420	194.40	233.28	272.16	311.04	349.92	388.80	427.68	466.56	505.44	544.32	583.20	420
435	201.34	241.61	281.88	322.15	362.42	402.69	442.96	483.23	523.49	563.76	604.03	435
450	208.28	249.94	291.60	333.26	374.91	416.57	458.23	499.88	541.54	583.20	624.85	450
465	215.22	258.27	301.32	344.36	387.40	430.45	473.50	516.54	559.58	602.64	645.68	465
480	222.17	266.60	311.04	355.47	399.91	444.34	488.77	533.20	577.64	622.08	666.51	480
495	229.11	274.94	320.76	366.58	412.41	458.23	504.05	549.88	595.70	641.52	687.34	495
510	236.05	283.27	330.48	377.69	424.90	472.11	519.32	566.54	613.74	660.96	708.16	510
525	243.00	291.60	340.20	388.80	437.40	486.00	534.60	583.20	631.80	680.40	729.00	525
540	249.94	299.93	349.92	399.90	449.89	499.88	549.87	599.86	649.84	699.84	749.82	540
555	256.88	308.26	359.64	411.02	462.39	513.77	565.15	616.52	667.90	719.28	770.65	555
570	263.83	316.60	369.36	422.13	474.89	527.66	580.43	633.19	685.96	738.72	791.49	570
585	270.77	324.92	379.08	433.23	487.39	541.54	595.69	649.84	704.00	758.16	812.31	585
600	277.71	333.26	388.80	444.34	499.89	555.43	610.97	666.52	722.06	777.60	833.14	600

NOTE.—In the above tables, 10 per cent. of the time is allowed for cleaning, oiling, etc.



COILER DRAWING FRAME (Front).



COILER DRAWING FRAME (Back).

Coiler Drawing Frame.

Our Coiler Drawing Frames are built from new and improved patterns, with coiler arranged for 10 in., 11 in., and 12 in. cans. Particular attention has been given to model each size coiler of correct dimensions to give best results for its particular sized can.

The drawing rolls. all of crucible steel, are in four lines, usually 16 in. in length from center to center of stands, and made for all slivers to run on a single boss for each delivery. Front roll $1\frac{3}{8}$ in. diam., back and middle rolls $1\frac{1}{8}$ in. diam. Top rolls are leather covered, the front roll being shell or loose boss. Back and middle rolls solid unless otherwise ordered. The rolls are weighted by lever or direct weighting as desired, either style being provided with weight relief motion.

Stop motions are mechanical throughout, and consist of back, front, and full can stop. All are simple and sure in action, and are not likely to get out of order. Our patented full can stop is operated by only a slight pressure of the cotton on the face of coiler when the can becomes filled. This point will be appreciated, as cans are never overfilled, and cotton thereby too closely packed into the can to run well in subsequent operations.

Calender rolls are arranged to give adjustable pressure, and this device can be securely locked in place with no chance of being tampered with afterwards. Overseers can thus set calender rolls for the desired condensing of sliver at any time.

Can tables are simple and can be set on top floor, or cut in and placed on mill planking. All parts of coilers and can tables are made so as to be readily taken apart without the use of tools, but are firmly set together when running.

All roll gears are machine cut, and studs carrying roll gears are strongly supported so there will be no giving to strains or torsion. A roller traverse motion is applied if desired, and the frame also arranged to be used for combed stock. Frame usually belted from below.

Driving Pulleys on lower shaft are from 8 in. diam. to 16 in. diam., and from $1\frac{7}{8}$ in. face to $5\frac{1}{2}$ in. face, and run same number of revolutions as front roll.

Floor Space, exclusive of driving pulleys and sides of frame, tables 9 in. wide, and lengths as follows:—

16 in. Length of Rolls.

3 lengths of rolls,			3 boss.		Whole length of table,		5 ft.	6 in.	3 deliverers.	
4	"	"	4	"	"	"	6	10	4	"
5	"	"	5	"	"	"	8	2	5	"
6	"	"	6	"	"	"	9	6	6	"

To obtain length of frame over all, add 17 in. to table lengths given above.

Can tables for 10, 11, and 12 in. diam. cans.

Drawing Frame.

This machine is provided with four lines of steel rollers, the front roll being $1\frac{3}{8}$ in. diameter, and the back and middle $1\frac{1}{8}$ in. The lengths of rollers are $14\frac{1}{4}$ in., 16 in., $17\frac{1}{4}$ in. and 18 in. between centers of stands, and are made single boss. The frames are usually made up in 3, 4, and 6 lengths of rolls, which we name 3 boss, 4 boss, and 6 boss frames. They are provided with both front and back stop-motions. The top rolls are weighted at the ends by an "evening" bar in combination with the actual weight lever underneath the table, thus ensuring equal pressure upon both ends of the rolls, or they may be weighted direct. A device is also provided whereby all pressure may be at once removed from the top rolls without detaching the weights from their respective levers. A counter movement again restores the pressure to the rolls.

Driving Pulleys on lower shaft are 9 in., 12 in., and 16 in. diameter and 2 in. to 4 in. face, and run the same number of revolutions as the $1\frac{3}{8}$ in. diameter front roll. Floor Room exclusive of pulleys, tables 9 in. wide, and lengths as follows:—

$14\frac{1}{4}$ in. Length of Rolls.

3	lengths of rolls,		3	boss.	Whole length of table,		5	ft.		3 deliverers.
4	"	"	4	"	"	"	6		2 in.	4 "
5	"	"	5	"	"	"	7		5	5 "
6	"	"	6	"	"	"	8		7	6 "
7	"	"	7	"	"	"	9		9	7 "
8	"	"	8	"	"	"	11			8 "

16 in. Length of Rolls.

3	lengths of rolls,		3	boss.	Whole length of table,		5	ft.	6 in.	3 deliverers.
4	"	"	4	"	"	"	6		10	4 "
5	"	"	5	"	"	"	8		2	5 "
6	"	"	6	"	"	"	9		6	6 "

$17\frac{1}{4}$ in. Length of Rolls.

3	lengths of rolls,		3	boss.	Whole length of table,		5	ft.	9 in.	3 deliverers.
4	"	"	4	"	"	"	7		2	4 "
5	"	"	5	"	"	"	8		$7\frac{1}{4}$	5 "
6	"	"	6	"	"	"	10			6 "

18 in. Length of Rolls.

2	lengths of rolls,		2	boss.	Whole length of table,		4	ft.	5 in.	2 deliverers.
3	"	"	3	"	"	"	5		11	3 "
4	"	"	4	"	"	"	7		5	4 "
6	"	"	6	"	"	"	10		5	6 "

Tables:—See Table of Production, also Change Draught Gear Table.

Can Tables:—9, 10, 11, 12, 14, 16, 18 in. diameter.

Table of Draughts
Drawing Frames and Railway or Card Head.

Drawing Frames.

4 Rolls. Dia. of { Front Roll, 1⅜ in. / Back Roll, 1⅛ in.

Back Roll Change Gear.	Front Roll Change Gear.	Draught.
70 T	13 T	6.581
70	14	6.111
70	15	5.703
70	16	5.347
70	17	5.032
70	18	4.753
70	19	4.503
70	20	4.277
70	21	4.074
70	22	3.889
70	23	3.720
70	24	3.565
70	25	3.422
70	26	3.252
70	27	3.131
70	28	3.055
70	29	2.950
70	30	2.852
70	31	2.760
70	32	2.673

Drawing Frames.

4 Rolls. Dia. of { Front Roll, 1⅜ in. / Back Roll, 1⅛ in.

Back Roll Change Gear.	Front Roll Change Gear.	Draught.
71 T	13 T	6.675
71	14	6.198
71	15	5.785
71	16	5.424
71	17	5.105
71	18	4.821
71	19	4.620
71	20	4.339
71	21	4.132
71	22	3.944
71	23	3.773
71	24	3.616
71	25	3.471
71	26	3.338
71	27	3.214
71	28	3.099
71	29	2.992
71	30	2.893
71	31	2.799
71	32	2.712

Drawing Frames.

4 Rolls. Dia. of { Front Roll, 1⅜ in. / Back Roll, 1⅛ in.

Back Roll Change Gear.	Front Roll Change Gear.	Draught.
72 T	13 T	6.769
72	14	6.286
72	15	5.867
72	16	5.500
72	17	5.177
72	18	4.889
72	19	4.632
72	20	4.400
72	21	4.191
72	22	4.000
72	23	3.826
72	24	3.658
72	25	3.520
72	26	3.385
72	27	3.259
72	28	3.143
72	29	3.035
72	30	2.933
72	31	2.839
72	32	2.750

Finisher Railway Head.

4 Rolls. Dia. of { Front Roll, 1⅜ in. / Back Roll, 1⅛ in.
Rev. of Back Roll, $\frac{298}{1000}$ to 1 of Cones.

Front Roll Gear.	Change Pinion on Cone.	Draught.
24 T	14 T	2.3926
24	15	2.5635
24	16	2.7344
24	17	2.9053
24	18	3.0762
24	19	3.2471
24	20	3.4180
24	21	3.5889
24	22	3.7598
24	23	3.9307
24	24	4.1017
24	25	4.2725
24	26	4.4434
24	27	4.6143
24	28	4.7852
24	30	5.1270
24	32	5.4688
24	34	5.8106
24	36	6.1524
24	38	6.4942
24	40	6.8360
24	42	7.1778
24	45	7.6905

THE WHITIN DRAWING FRAME.

Table showing the number of pounds of Drawing Sliver produced in one day of 10 hours.

Rev. of 1⅜ in. front roll per m.	NUMBER OF GRAINS IN ONE YARD OF SLIVER.											Rev. of 1⅜ in. front roll per m.
	30	35	40	45	50	55	60	65	70	75	80	
	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	
200	49.37	57.60	65.83	74.06	82.28	90.31	98.74	106.97	115.20	123.42	131.66	200
210	51.84	60.48	69.12	77.76	86.40	95.04	103.68	112.32	120.96	129.60	138.24	210
220	54.31	63.36	72.41	81.46	90.51	99.56	108.62	117.67	126.72	135.77	144.82	220
230	56.78	66.24	75.70	85.16	94.63	104.09	113.56	123.01	132.48	141.94	151.40	230
240	59.24	69.12	78.99	88.87	98.74	108.61	118.48	128.36	138.24	148.11	157.98	240
250	61.71	72.00	82.28	92.57	102.86	113.14	123.42	133.71	144.00	154.29	164.56	250
260	64.18	74.88	85.58	96.27	106.97	117.67	128.36	139.06	149.76	160.46	171.16	260
270	66.65	77.76	88.87	99.98	111.08	122.19	133.30	144.41	155.52	166.62	177.74	270
280	69.12	80.64	92.16	103.68	115.20	126.72	138.24	149.76	161.28	172.80	184.32	280
290	71.59	83.52	95.45	107.38	119.31	131.24	143.18	155.11	167.04	178.97	190.90	290
300	74.06	86.40	98.74	111.08	123.43	135.77	148.12	160.46	172.80	185.14	197.48	300
310	76.53	89.28	102.04	114.79	127.54	140.30	153.06	165.80	178.56	191.31	204.08	310
320	78.99	92.16	105.33	118.49	131.66	144.82	157.98	171.15	184.32	197.48	210.66	320
330	81.46	95.04	108.62	122.19	135.77	149.35	162.92	176.50	190.08	203.66	217.24	330
340	83.93	97.92	111.91	125.90	139.89	153.88	167.86	181.85	195.84	209.83	223.82	340
350	86.40	100.80	115.20	129.60	144.00	158.40	172.80	187.20	201.60	216.00	230.40	350
360	88.87	103.68	118.49	133.30	148.11	162.92	177.74	192.55	207.36	222.17	236.98	360
370	91.34	106.56	121.78	137.01	152.23	167.45	182.68	197.90	213.12	228.34	243.56	370
380	93.80	109.44	125.08	140.72	156.35	171.98	187.60	203.25	218.88	234.52	250.16	380
390	96.27	112.32	128.37	144.41	160.46	176.50	192.54	208.60	224.64	240.69	256.74	390
400	98.74	115.20	131.66	148.11	164.57	181.03	197.48	213.94	230.40	246.86	263.32	400

NOTE.—In the above tables, 20 per cent. of the time is allowed for cleaning, oiling, etc.

Production of Fly Frames.

Number of Roving.	Grains per Yard.	Twist per Inch.	POUNDS PER DAY PER SPINDLE.							
			SLUBBER.			INTERMEDIATE.		ROVING.		JACK.
			10 in. Space.	9 in. Space.	9 in. Space.	7 in. Space.	6 in. Space.	5 in. Space.	$4\frac{1}{2}$ in. Space.	$4\frac{1}{4}$ in. Space.
.20	41.67	.54	58.71							
.30	27.78	.66	41.60	39.09						
.40	20.83	.76	31.19	30.69	29.36					
.50	16.67	.85	24.03	24.29	23.99					
.60	13.89	.93	19.32	20.05	19.95					
.70	11.90	1.00	15.75	16.60	16.92					
.80	10.42	1.07	13.25	14.13	14.46					
.90	9.26	1.14	11.24	12.04	12.36	13.92				
1.00	8.33	1.20	9.83	10.64	10.97	12.33	12.88			
1.10	7.57	1.26	. . .	10.48	9.75	11.15	11.75			
1.20	6.94	1.31	. . .	. . .	8.70	10.16	10.65			
1.30	6.41	1.37	. . .	. . .	. . .	9.03	9.50			
1.40	5.95	1.42	. . .	. . .	. . .	8.21	8.75			
1.50	5.55	1.47	. . .	. . .	. . .	7.52	8.15			
1.60	5.20	1.52	. . .	. . .	. . .	6.89	7.64			
1.70	4.90	1.56	. . .	. . .	. . .	5.91	7.19			
2.00	4.16	1.70	. . .	. . .	. . .	. . .	5.63	5.87		
2.25	3.70	1.80	. . .	. . .	. . .	. . .	4.94	5.21		
2.50	3.33	1.89	. . .	. . .	. . .	. . .	4.21	4.45		
2.75	3.03	1.98	. . .	. . .	. . .	. . .	3.72	3.86		
3.00	2.77	2.08	. . .	. . .	. . .	. . .	3.32	3.54	3.57	
3.50	2.38	2.24	. . .	. . .	. . .	. . .	. . .	2.93	3.06	
4.00	2.08	2.40	. . .	. . .	. . .	. . .	. .	2.39	2.45	
4.50	1.85	2.54	. . .	. . .	. . .	. . .	. . .	2.07	2.18	
5.00	1.67	2.68	. . .	. . .	. . .	. . .	. . .	1.75	1.83	
5.50	1.51	2.81	. . .	. . .	. . .	. . .	. . .	1.54	1.67	
6.00	1.38	2.94	. . .	. . .	. . .	. . .	. . .	1.37	1.43	
7.00	1.19	3.17	. . .	. . .	. . .	. . .	. . .	. . .	1.15	
8.00	1.04	3.39	. . .	. . .	. .	. . .	. . .	. . .	.965	
9.00	.92	3.60	. . .	. . .	. . .	. . .	. . .	. . .	.787	
10.00	.83	3.79	. . .	. . .	. . .	. . .	. . .	. . .	.675	.822
11.00	.76	3.98	. . .	. . .	. . .	. . .	. . .	. . .	.614	.747
12.00	.69	4.16	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.622
14.00	.59	4.49	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.497
16.00	.52	4.80	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.410
18.00	.46	5.09	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.355
20.00	.42	5.37	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.297
22.00	.38	5.63	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.262
24.00	.35	5.88	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.233
26.00	.32	6.12	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.206
Rev. of Pulley per Minute.			344	391	392	490	441	423	456	556
Rev. of Flyer per Minute.			660	750	800	1000	1150	1300	1400	1700
Size of Full Bobbin,			$12''$x$6\frac{1}{8}''$	$11''$x$5\frac{5}{8}''$	$10''$x$5\frac{1}{8}''$	$9''$x$4\frac{5}{8}''$	$8''$x$4\frac{1}{8}''$	$7''$x$3\frac{5}{8}''$	$6''$x$3\frac{1}{8}''$	$5''$x$2\frac{1}{2}''$
Cotton on Full Bobbin,			46 oz.	33 oz.	27 oz.	21 oz.	16 oz.	$10\frac{1}{2}$ oz.	$7\frac{1}{2}$ oz.	4 oz.

Table for Numbering Roving by Grains.

No. of Roving.	Grains per Yard.	Grains per Hank.	No. of Roving.	Grains per Yard.	Grains per Hank.	No. of Roving.	Grains per Yard.	Grains per Hank.	No. of Roving.	Grains per Yard.	Grains per Hank.
.10	83.33	70000.	1.3	6.41	5384.	3½	2.38	2000.	6¾	1.234	1037.00
.15	55.56	46666.	1.4	5.95	5000.	3¾	2.22	1866.	7	1.190	1000.00
.20	41.66	35000.	1.5	5.55	4666.	4	2.08	1750.	7¼	1.149	965 50
.30	27.77	23333.	1.6	5.20	4375.	4¼	1.96	1647.	7½	1.111	933.30
.40	20.83	17500.	1.7	4.90	4117.	4½	1.85	1555.	7¾	1.075	903.20
.50	16.66	14000.	1.8	4.62	3888.	4¾	1.75	1473.	8	1.041	875.00
.60	13.88	11666.	1.9	4.38	3684.	5	1.66	1400.	8¼	1.010	848.40
.70	11.90	10000.	2.0	4.16	3500.	5¼	1.58	1333.	8½	.980	823.50
.80	10.41	8750.	2¼	3.70	3111.	5½	1.51	1272.	8¾	.952	800.00
.90	9.25	7777.	2½	3.33	2800.	5¾	1.44	1217.	9	.925	777.77
1.00	8.33	7000.	2¾	3.03	2545.	6	1.38	1166.			
1.10	7.57	6363.	3.	2.77	2333.	6¼	1.33	1120.			
1.20	6.94	5833.	3¼	2.56	2153.	6½	1.28	1076.			

Table for Numbering Yarn by Grains.

No. of Yarn.	Grains per Hank.	No. of Yarn.	Grains per Hank.	No. of Yarn.	Grains per Hank.	No. of Yarn.	Grains per Hank.	No. of Yarn.	Grains per Hank.	No. of Yarn.	Grains per Hank.
9	777.77	20¼	344.44	31½	222.22	42¾	163.74	54	129.62	81	86.40
9¼	756.75	20½	341.46	31¾	220.47	43	162.79	54¼	129.03	82	85.40
9½	736.84	20¾	337.34	32	218.75	43¼	161.84	54½	128.44	83	84.30
9¾	720.51	21	333.33	32¼	217.05	43½	160.91	54¾	127.85	84	83.30
10	700.00	21¼	329.41	32½	215.38	43¾	160.00	55	127.27	85	82.40
10¼	682.92	21½	325.58	32¾	213.74	44	159.09	55¼	126.69	86	81.40
10½	666.66	21¾	321.83	33	212.12	44¼	158.19	55½	126.12	87	80.40
10¾	651.16	22	318.18	33¼	210.52	44½	157.41	55¾	125.56	88	79.50
11	636.36	22¼	314.60	33½	208.95	44¾	156.42	56	125.00	89	78.60
11¼	622.22	22½	311.11	33¾	207.40	45	155.55	56¼	124.49	90	77.80
11½	608.69	22¾	307.69	34	205.88	45¼	154.69	56½	123.89	91	76.90
11¾	595.74	23	304.34	34¼	204.30	45½	153.84	56¾	123.34	92	76.10
12	583.33	23¼	301.07	34½	202.89	45¾	152.95	57	122.80	93	75.30
12¼	571.42	23½	297.87	34¾	201.43	46	152.17	57¼	122.27	94	74.50
12½	560.00	23¾	294.73	35	200.00	46¼	151.30	57½	121.73	95	73.70
12¾	549.01	24	291.66	35¼	198.58	46½	150.53	57¾	121.21	96	72.90
13	546.15	24¼	288.65	35½	197.32	46¾	149.73	58	120.68	97	72.30
13¼	526.11	24½	285.71	35¾	195.80	47	148.93	58¼	120.17	98	71.40
13½	518.51	24¾	282.82	36	194.44	47¼	148.14	58½	119.65	99	70.70
13¾	509.09	25	280.00	36¼	193.10	47½	147.34	58¾	119.14	100	70.00
14	500.00	25¼	277.22	36½	191.78	47¾	146.59	59	118.47	105	66.70
14¼	491.22	25½	274.50	36¾	190.47	48	145.83	59¼	118.14	110	63.60
14½	482.75	25¾	271.84	37	189.18	48¼	145.07	59½	117.64	115	60.90
14¾	474.57	26	269.23	37¼	187.91	48½	144.32	59¾	117.15	120	58.30
15	466.66	26¼	266.66	37½	186.66	48¾	143.58	60	116.66	125	56.00
15¼	459.01	26½	264.15	37¾	185.42	49	142.85	61	114.80	130	53.80
15½	451.61	26¾	261.68	38	184.21	49¼	142.13	62	112.90	135	51.80
15¾	444.44	27	259.25	38¼	183.00	49½	141.41	63	111.10	140	50.00
16	437.50	27¼	256.88	38½	181.81	49¾	140.70	64	109.30	145	48.30
16¼	430.76	27½	254.54	38¾	180.63	50	140.00	65	107.70	150	46.70
16½	424.24	27¾	252.52	39	179.48	50¼	139.30	66	106.10	155	45.20
16¾	417.91	28	250.00	39¼	178.34	50½	138.61	67	104.40	160	43.80
17	411.76	28¼	247.78	39½	177.21	50¾	137.93	68	102.90	165	42.40
17¼	405.79	28½	245.61	39¾	176.10	51	137.29	69	101.40	170	41.20
17½	400.00	28¾	243.46	40	175.00	51¼	136.58	70	100.00	175	40.00
17¾	394.36	29	241.37	40¼	173.91	51½	135.92	71	98.60	180	38.90
18	388.88	29¼	239.31	40½	172.83	51¾	135.26	72	97.20	185	37.80
18¼	383.56	29½	237.28	40¾	171.77	52	134.61	73	95.90	190	36.80
18½	378.37	29¾	235.29	41	170.73	52¼	133.97	74	94.60	195	35.90
18¾	373.33	30	233.33	41¼	169.69	52½	133.33	75	93.30	200	35.00
19	368.42	30¼	231.40	41½	168.67	52¾	132.70	76	92.10		
19¼	363.63	30½	229.50	41¾	167.66	53	132.07	77	90.90		
19½	358.97	30¾	227.64	42	166.66	53¼	131.45	78	89.70		
19¾	354.43	31	225.80	42¼	165.68	53½	130.84	79	88.60		
20	350.00	31¼	224.08	42½	164.70	53¾	130.23	80	87.50		

Roving Twist Tables.

Hank Roving.	Square Root.	Twist per Inch.	Coils per Inch on Bobbin.	Hank Roving.	Square Root.	Twist per Inch.	Coils per Inch on Bobbin.
½	.7071	.848	6.576	7	2.6457	3.174	24.605
⅝	.7910	.949	7.358	7⅛	2.6692	3.203	24.823
¾	.8660	1.039	8.052	7¼	2.6925	3.231	25.040
⅞	.9354	1.122	8.699	7⅜	2.7156	3.258	25.255
1	1.0000	1.200	9 300	7½	2.7386	3.286	25.468
1⅛	1.0606	1.272	9.863	7⅝	2.7613	3.313	25.679
1¼	1.1180	1.341	10.397	7¾	2.7838	3.340	25.890
1⅜	1.1726	1.407	10.805	7⅞	2.8062	3.367	26.107
1½	1.2247	1.469	11.389	8	2.8284	3.394	26.304
1⅝	1.2747	1.529	11.849	8⅛	2.8504	3.420	26.519
1¾	1.3228	1.587	12.302	8¼	2.8722	3.446	26.712
1⅞	1.3688	1.643	12.734	8⅜	2.8939	3.472	26.913
2	1.4142	1.697	13.152	8½	2.9154	3.498	27.113
2⅛	1.4577	1.749	13.556	8⅝	2.9368	3.524	27.312
2¼	1.5000	1.800	13.950	8¾	2.9580	3.549	27.509
2⅜	1.5411	1.849	14.331	8⅞	2.9790	3.574	27.705
2½	1.5811	1.897	14.704	9	3.0000	3.600	27.900
2⅝	1.6201	1.944	15.067	9⅛	3.0201	3.624	28.092
2¾	1.6583	1.989	15.422	9¼	3.0413	3.649	28.284
2⅞	1.6956	2.034	15.768	9⅜	3.0618	3.674	28.475
3	1.7320	2.078	16.107	9½	3.0824	3.698	28.664
3⅛	1.7677	2.121	16.439	9⅝	3.1024	3.722	28.852
3¼	1.8027	2.163	16.765	9¾	3.1224	3.746	29.039
3⅜	1.8371	2.204	17.085	9⅞	3.1424	3.770	29.224
3½	1.8708	2.244	17.391	10	3.1622	3.794	29.409
3⅝	1.9034	2.284	17.701	10⅛	3.1815	3.817	29.582
3¾	1.9364	2.323	18.203	10¼	3.2015	3.841	29.774
3⅞	1.9685	2.362	18.313	10⅜	3.2210	3.865	29.945
4	2.0000	2.400	18.600	10½	3.2403	3.888	30.135
4⅛	2.0310	2.437	18.886	10⅝	3.2596	3.911	30.314
4¼	2.0615	2.473	19.165	10¾	3.2788	3.934	30.492
4⅜	2.0918	2.509	19.444	10⅞	3.2975	3.957	30.663
4½	2.1213	2.545	19.723	11	3.3166	3.979	30.834
4⅝	2.1505	2.580	20.000	11⅛	3.3354	4.002	31.019
4¾	2.1794	2.615	20.268	11¼	3.3541	4.024	31.193
4⅞	2.2078	2.649	20.533	11⅜	3.3726	4.047	31.365
5	2.2360	2.683	20.793	11½	3.3911	4.069	31.537
5⅛	2.2638	2.716	21.053	11⅝	3.4095	4.091	31.706
5¼	2.2912	2.749	21.308	11¾	3.4278	4.113	31.878
5⅜	2.3184	2.782	21.561	11⅞	3.4460	4.135	32.047
5½	2.3452	2.814	21.810	12	3.4641	4.156	32.216
5⅝	2.3717	2.846	22.057	12⅛	3.4820	4.178	32.382
5¾	2.3979	2.877	22.300	12¼	3.5000	4.200	32.550
5⅞	2.4238	2.908	22.541	12⅜	3.5176	4.221	32.716
6	2.4494	2.939	22.780	12½	3.5355	4.242	32.885
6⅛	2.4748	2.969	23.009	12⅝	3.5531	4.263	33.043
6¼	2.5000	3.000	23.250	12¾	3.5707	4.284	33.208
6⅜	2.5248	3.029	23.480	12⅞	3.5881	4.305	33.369
6½	2.5495	3.059	23.710	13	3.6055	4.326	33.536
6⅝	2.5739	3.088	23.938	14	3.7416	4.489	34.797
6¾	2.5980	3.117	24.161	15	3.8728	4.647	36.017
6⅞	2.6220	3.146	24.384				

English Twist Tables.

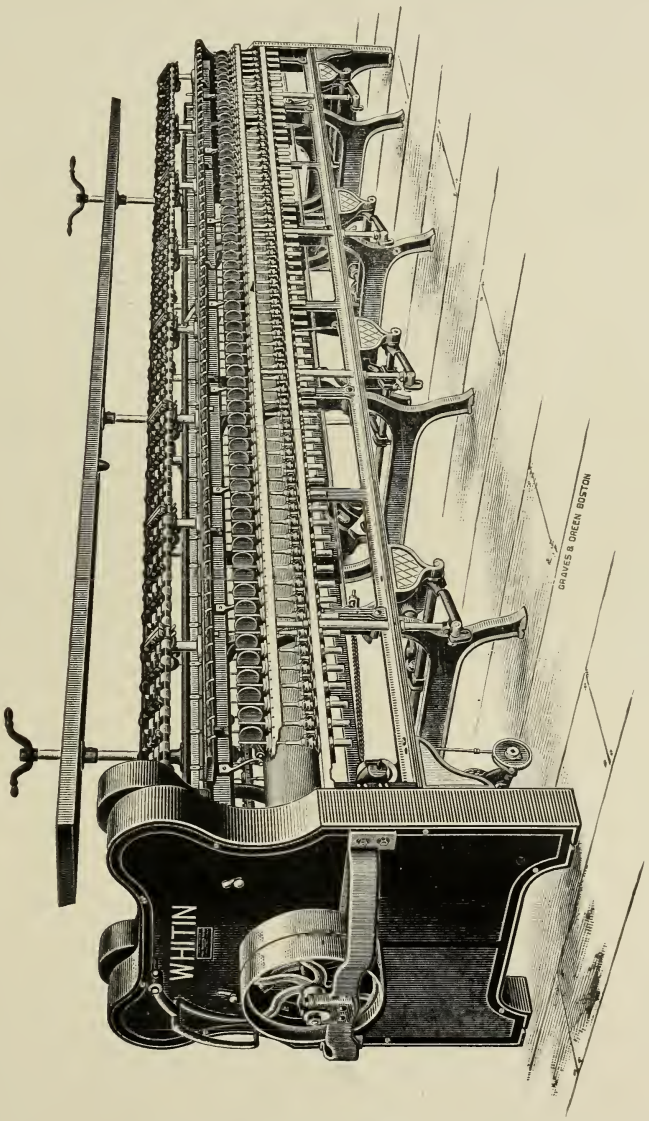
Counts or Numbers	Square Root.	Frame Warp Twist.	Extra Mule Twist.	Mule Twist.	Filling Twist.	Twist for Doubling.	Hosiery Yarn.
1	1.0000	4.75	4.00	3.75	3.25	2.75	2.50
2	1.4142	6.72	5.66	5.30	4.60	3.89	3.53
3	1.7320	8.23	6.93	6.49	5.63	4.76	4.33
4	2.0000	9.50	8.00	7.50	6.50	5.50	5.00
5	2.2360	10.62	8.94	8.38	7.27	6.15	5.59
6	2.4494	11.63	9.80	9.18	7.96	6.73	6.12
7	2.6457	12.56	10.58	9.92	8.60	7.27	6.61
8	2.8284	13.43	11.31	10.61	9.19	7.78	7.07
9	3.0000	14.25	12.00	11.25	9.75	8.25	7.50
10	3.1622	15.02	12.65	11.86	10.27	8.69	7.90
11	3.3166	15.75	13.26	12.44	10.78	9.12	8.29
12	3.4641	16.45	13.86	12.99	11.26	9.52	8.66
13	3.6055	17.12	14.42	13.52	11.72	9.91	9.01
14	3.7416	17.77	14.96	14.03	12.16	10.29	9.35
15	3.8729	18.39	15.49	14.52	12.59	10.65	9.68
16	4.0000	19.00	16.00	15.00	13.00	11.00	10.00
17	4.1231	19.58	16.49	15.46	13.40	11.34	10.31
18	4.2426	20.15	16.97	15.91	13.79	11.66	10.60
19	4.3588	20.70	17.43	16.35	14.17	11.98	10.89
20	4.4721	21.24	17.89	16.77	14.53	12.30	11.18
21	4.5825	21.76	18.33	17.18	14.89	12.60	
22	4.6904	22.27	18.76	17.59	15.24	12.89	
23	4.7958	22.78	19.8	17.98	15.59	13.19	
24	4.8989	23.27	19.59	18.37	15.92	13.47	
25	5.0000	23.75	20.00	18.75	16.25	13.75	
26	5.0990	24.22	20.39	19.12	16.57	14.02	
27	5.1961	24.68	20.78	19.49	16.89	14.29	
28	5.2915	25.13	21.16	19.84	17.20	14.55	
29	5.3851	25.58	21.54	20.19	17.50	14.81	
30	5.4772	26.02	21.91	20.54	17.80	15.06	
31	5.5677	26.44	22.27	20.88	18.10	15.31	
32	5.6568	26.87	22.63	21.21	18.38	15.55	
33	5.7445	27.28	22.98	21.54	18.67	15.80	
34	5.8309	27.69	23.32	21.87	18.95	16.03	
35	5.9160	28.10	23.66	22.19	19.23	16.27	
36	6.0000	28.50	24.00	22.50	19.50	16.50	
37	6.0827	28.89	24.33	22.81	19.77	16.72	
38	6.1644	29.28	24.66	23.12	20.03	16.95	
39	6.2449	29.66	24.98	23.41	20.30	17.17	
40	6.3245	30.04	25.30	23.72	20.55	17.39	
41	6.4031	30.42	25.61	24.01	20.81	17.61	
42	6.4807	30.78	25.92	24.30	21.06	17.82	
43	6.5574	31.14	26.23	24.59	21.31	18.03	
44	6.6332	31.50	26.53	24.87	21.56	18.24	
45	6.7082	31.86	26.83	25.16	21.80	18.45	
46	6.7823	32.21	27.13	25.43	22.04	18.65	
47	6.8556	32.56	27.42	25.70	22.28	18.85	
48	6.9282	32.90	27.71	25.98	22.52	19.05	
49	7.0000	33.25	28.00	26.25	22.75	19.25	
50	7.0710	33.58	28.28	26.52	22.98	19.44	

English Twist Tables. Continued.

Counts or Numbers.	Square Root.	Frame Warp Twist.	Extra Mule Twist.	Mule Twist.	Filling Twist.	Twist for Doubling.	Hosiery Yarn.
51	7.1414	33.92	28.56	26.78	23.21	19.64	
52	7.2111	34.25	28.84	27.04	23.44	19.83	
53	7.2801	34.58	29.12	27.30	23.66	20.02	
54	7.3484	34.90	29.39	27.56	23.88	20.21	
55	9.4161	35.22	29.66	27.81	24.10	20.39	
56	7.4833	35.54	29.93	28.06	24.32	20.58	
57	7.5498	35.86	30.20	28.31	24.53	20.76	
58	7.6157	36.17	30.46	28.56	24.75	20.94	
59	7.6811	36.48	30.72	28.80	24.96	21.12	
60	7.7459	36.79	30.98	29.04	25.16	21.30	
61	7.8102	37.10	31.24	29.29	25.38	21.48	
62	7.8740	37.40	31.49	29.53	25.59	21.65	
63	7.9372	37.70	31.74	29.76	25.79	21.83	
64	8.0000	38.00	32.00	30.	26.00	22.00	
65	8.0622	38.29	32.25	30.23	26.20	22.17	
66	8.1240	38.59	32.49	30.47	26.40	22.34	
67	8.1853	38.88	32.74	30.69	26.60	22.51	
68	8.2462	39.16	32.98	30.92	26.80	22.68	
69	8.3066	39.46	33.22	31.15	26.99	22.84	
70	8.3666	39.74	33.46	31.37	27.19	23.01	
71	8.4261	40.02	33.70	31.60	27.38	23.17	
72	8.4852	40.30	33.94	31.82	27.58	23.33	
73	8.5440	40.58	34.17	32.04	27.77	23.50	
74	8.6023	40.86	34.41	32.26	27.96	23.65	
75	8.6602	41.14	34.64	32.48	28.14	23.81	
76	8.7177	41.41	34.87	32.69	28.33	23.97	
77	8.7749	41.68	35.09	32.90	28.51	24.13	
78	8.8317	41.95	35.32	33.12	28.70	24.28	
79	8.8881	42.22	35.55	33.33	28.89	24.44	
80	8.9442	42.48	35.77	33.54	29.07	24.60	
81	9.0000	42.75	36.00	33.75	29.25	24.75	
82	9.0553	43.01	36.22	33.96	29.43	24.90	
83	9.1104	43.27	36.44	34.16	29.61	25.05	
84	9.1651	43.53	36.66	34.37	29.79	25.20	
85	9.2195	43.79	36.88	34.57	29.96	25.35	
86	9.2736	44.05	37.09	34.77	30.14	25.50	
87	9.3273	44.30	37.31	34.98	30.31	25.65	
88	9.3808	44.56	37.52	35.18	30.48	25.79	
89	9.4339	44.81	37.73	35.37	30.66	25.94	
90	9.4868	45.06	37.95	35.57	30.83	26.09	
91	9.5393	45.31	38.16	35.77	31.00	26.23	
92	9.5916	45.56	38.36	35.97	31.17	26.37	
93	9.6436	45.80	38.57	36.16	31.34	26.52	
94	9.6953	46.05	38.78	36.36	31.51	26.66	
95	9.7467	46.30	38.98	36.55	31.67	26.80	
96	9.7979	46.54	39.19	36.74	31.84	26.94	
97	9.8488	46.78	39.39	36.93	32.01	27.08	
98	9.8994	47.02	39.60	37.12	32.17	27.22	
99	9.9498	47.26	39.80	37.31	32.33	27.36	
100	10.0000	47.50	40.00	37.50	32.50	27.50	

English Table of Breaking Weights.

ORDINARY QUALITY.			FAIR QUALITY.			GOOD QUALITY.			EXTRA QUALITY.			SUP. EXTRA QUALITY.		
No. Yarn.	Breaking Weight.		No. Yarn	Breaking Weight.		No. Yarn.	Breaking Weight.		No. Yarn.	Breaking Weight.		No. Yarn.	Breaking Weight.	
	lbs.	oz.		lbs.	oz.		lbs.	oz.		lbs.	oz.		lbs.	oz.
10	115	10	10	120	8	10	125	6	10	130	4	10	135	3
11	102	4	11	104	7	11	106	10	11	108	14	11	111	2
12	96	15	12	99	2	12	100	5	12	103	8	12	105	12
13	91	14	13	93	15	13	96	0	13	98	2	13	100	4
14	89	12	14	91	12	14	93	13	14	95	14	14	97	15
15	83	12	15	85	10	15	87	8	15	89	7	15	91	6
16	81	11	16	83	8	16	85	6	16	87	4	16	89	2
17	76	14	17	78	10	17	80	6	17	82	2	17	83	14
18	72	10	18	74	4	18	75	14	18	77	8	18	79	3
20	67	14	20	69	6	20	70	14	20	72	7	20	74	0
22	61	11	22	63	1	22	64	7	22	65	14	22	67	5
24	58	10	24	59	15	24	61	4	24	62	9	24	63	15
26	54	10	26	55	13	26	57	1	26	58	5	26	59	9
28	50	4	28	51	6	28	52	8	28	53	10	28	54	13
30	48	11	30	49	12	30	50	13	30	51	14	30	53	0
32	45	9	32	46	7	32	47	5	32	48	3	32	49	2
34	44	6	34	45	6	34	46	6	34	47	6	34	48	6
36	41	14	36	42	13	36	43	12	36	44	11	36	45	11
38	39	11	38	40	9	38	41	7	38	42	6	38	43	5
40	38	15	40	39	13	40	40	11	40	41	9	40	42	8
42	37	13	42	38	10	42	39	8	42	40	6	42	41	4
44	35	7	44	36	3	44	37	0	44	37	13	44	38	10
46	33	13	46	34	9	46	35	5	46	36	1	46	36	14
48	32	3	48	32	14	48	34	9	48	34	5	48	35	1
50	32	2	50	32	13	50	33	8	50	34	4	50	35	0
55	30	8	55	31	3	55	31	14	55	32	9	55	33	5
60	27	10	60	28	4	60	28	14	60	29	8	60	30	2
65	25	8	65	26	1	65	26	10	65	27	3	65	27	13
70	24	6	70	24	15	70	25	8	70	26	1	70	26	10
75	22	12	75	23	4	75	23	12	75	24	4	75	24	13
80	22	0	80	22	8	80	23	0	80	23	18	80	24	0
85	20	4	85	20	13	85	21	6	85	21	15	85	22	8
90	19	8	90	19	3	90	19	14	90	20	9	90	21	5
95	18	8	95	18	14	95	19	5	95	19	12	95	20	3
100	18	4	100	18	10	100	19	0	100	19	6	100	19	12
110	15	10	110	16	0	110	16	5	110	16	11	110	17	0
120	15	8	120	15	13	120	16	2	120	16	7	120	16	13
130	14	4	130	14	9	130	14	14	130	15	3	130	15	9
140	13	10	140	13	15	140	14	4	140	14	9	140	14	14
150	12	7	150	12	11	150	12	15	150	13	4	150	13	9
160	12	4	160	12	8	160	12	12	160	13	0	160	13	5
170	11	9	170	11	13	170	12	1	170	12	5	170	12	9
180	10	10	180	10	13	180	11	1	180	11	5	180	11	9
190	10	9	190	10	12	190	11	0	190	11	4	190	11	8
200	10	4	200	10	7	200	10	11	200	10	15	200	11	3
210	9	13	210	10	0	210	10	3	210	10	7	210	10	11
220	9	13	220	9	15	220	10	1	220	10	4	220	10	7
230	9	3	230	9	6	230	9	9	230	9	12	230	10	0
240	8	14	240	9	1	240	9	4	240	9	7	240	9	11
250	8	10	250	8	13	250	9	0	250	9	3	250	9	7
260	8	8	260	8	11	260	8	14	260	9	1	260	9	4
270	8	3	270	8	6	270	8	9	270	8	12	270	8	15
280	8	1	280	8	4	280	8	7	280	8	10	280	8	13
290	7	12	290	7	15	290	8	2	290	8	5	290	8	8
300	7	11	300	7	13	300	8	8	300	8	3	300	8	6
310	7	7	310	7	9	310	7	12	310	7	15	310	8	2
320	7	6	320	7	8	320	7	10	320	7	13	320	8	0
330	7	2	330	7	4	330	7	17	330	7	10	330	7	13
340	6	15	340	7	1	340	7	3	340	7	6	340	7	9
350	6	14	350	7	0	350	7	2	350	7	5	350	7	8



RING SPINNING FRAME.

New Model Warp and Filling Ring Spinning Frames.

Frames are built 36 and 39 in. wide, and in lengths to suit rooms from 112 to 304 spindles each. They are provided with boxed end, and outboard bearing for end of pulley arbor. All gears from cylinder to rolls are cut on automatic gear-cutting machines, insuring accuracy and quiet running. All gearing being at one end of the frame, the labor in making changes is reduced to the lowest point. Gears are all placed in the closed boxed end, and operatives are entirely protected from accidents. The gears are convenient to get at, and are arranged for a wide variation of draft and twist by the change of a single gear. The spindle rails of the frame are webbed between the sampsons as well as at them. This makes them very strong and rigid, decreasing the liability of springing or twisting, which tends to produce bad bobbins by binding the lifting rods. The latter are protected by uniting the bushings formerly used top and bottom by a polished tube. This prevents the collection of lint at a point where it is apt to give trouble, and further protects the rod from accidental blows. Frames are usually made to change twist by changing speed of front roll. Our new model, however, if so ordered, may be built so that the roll speed will remain constant, and the variation in twist be affected by altering speed of spindles. The advantage of this arrangement is greatest when only slight changes of twist are required. This feature is accomplished without complication, and frames may be changed from one "drive" to another with slight expense. Pulleys may be placed at either the head or foot of frame. We advise the head or geared end, as by this arrangement the strain of the rolls is taken off the cylinder entirely. The builder motion has been remodelled, and is now arranged with least number of parts from first gear to heart cam in order to do away with all back lash. Parts are made stronger and stiffer, so it is possible to run "wave" much slower than formerly, and so get more yarn on the bobbins. The builder motion is arranged for either warp or filling wind. All oiling of studs and bearings in the boxed end of frame is affected from the outside without opening doors or casings. A saving in oil is also attained. Cylinder boxes are made on the self-oiling principle, a little fresh oil once a week being all that is required. A new form of our automatic separator, positive in its action, is applied to the frame. The blades are moved forward to their position to prevent ballooning, as well as lifted out of the path of the ring rail, positively, and are not allowed to fall back by gravity as in the old style. The blades are turned back for doffing by means of a patented separable clutch, which operates when the blades are lifted against the actuating mechanism. Either cast or stamped blades may be used. A detailed descripton of the separator will be found elsewhere. A

simple and effective device is applied to lift the guide eyes simultaneously for doffing. The cap bars are arranged to work independently, the finger at each roll bearing being divided, so that when the bar is thrown back, only its own particular set of top rolls need be removed. Ample space is left between the halves of the cap bar finger over the roll bearings for oiling. The roll stands are made wider than in former patterns insuring long life to the necks of rolls. The fluted boss on either side of the roll stands is drawn half an inch away from the bearing to avoid carrying oil to the top rolls. The traverse is from $4\frac{1}{2}$ to 7 inches. Frames are made to spin filling successfully, as compared with mules, from No. 8 to No 60; and warp as high as No. 105. Frames are equipped with Whitin Gravity, Draper, Rabbeth, Sherman, or McMullan spindles, as desired. Rings adjustable with three screws. Creels for double or single roving.

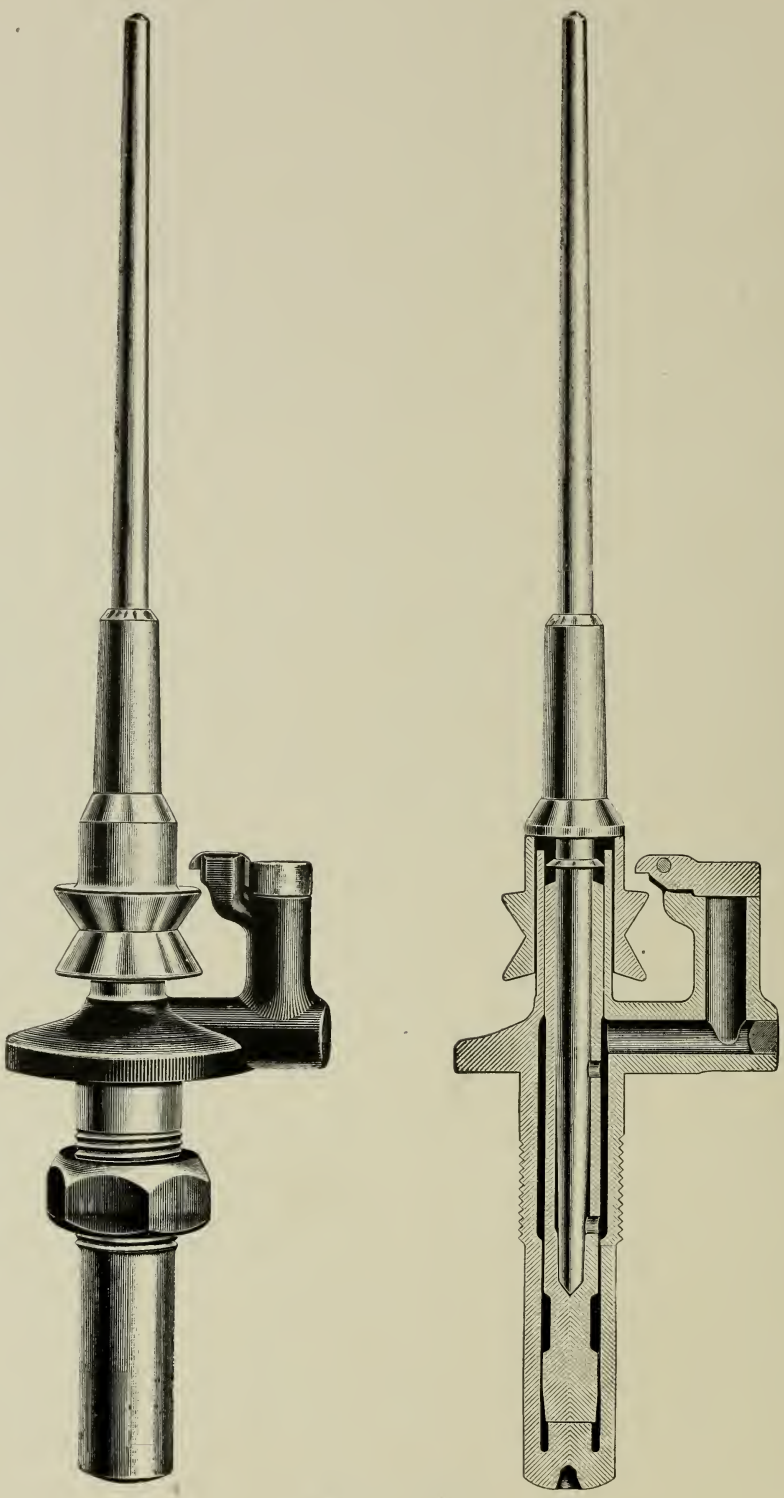
CYLINDERS:—7 in. and 8 in. diameter.

PULLEYS:—From 6 in. dia. to 16 in. dia., varying 1 in. each size; faces from 2 to 3 in. For number of revolutions of front rollers and spindles, see Tables of Production.

TABLES:—See tables for Change Draft and Twist Gearing for the Whitin Frames; also Tables of Production, and English Standard Twist, for warp and filling yarns, all of which will be found useful to spinners operating frames.

FLOOR SPACE:—Width 39 and 36 in., and lengths over all as follows

Number of Spindles.	$2\frac{1}{2}$ Inches Space.		$2\frac{5}{8}$ Inches Space.		$2\frac{3}{4}$ Inches Space.		3 Inches Space.		$3\frac{1}{4}$ Inches Space.	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
112	13	9	14	4	14	11				
128	15	5	16	1	16	9				
144	17	1	17	10	18	7				
160	18	9	19	7	20	5				
176	20	5	21	4	22	3				
192	22	1	23	1	24	1				
208	23	9	24	10	25	11				
224	25	5	26	7	27	9				
240	27	1	28	4	29	7				
256	28	9	30	1	31	5				
272	30	5	31	10	33	3				
288	32	2	33	8	35	2				
304	33	10	35	5	37	0				
120							17	1	18	4
132							18	7	19	$11\frac{1}{2}$
144							20	1	21	7
156							21	7	23	$2\frac{1}{2}$
168							23	1	24	10
180							24	7	26	$5\frac{1}{2}$
192							26	1	28	1
204							27	7	29	$8\frac{1}{2}$
216							29	3	31	$5\frac{3}{4}$
228							30	11	33	$3\frac{1}{4}$



GRAVITY SPINDLE.

The Gravity Spindle.

The Gravity Spindle has now been in use over ten years, and the fact that there are 1,800,000 of them sold to many of the best mills in the country, attests their practical utility, and the high degree of favor they have received from manufacturers. The reputation this spindle has acquired is based largely upon the fact that it is simple in construction and durable. Some of the spindles have been run at a speed of 12,000 turns a minute for several years without any perceptible evidence of wear. The whole structure of bolster, spindle, bobbin, and its yarn load rests upon a solid pin milled into the bottom of the bolster case. To prevent the escapement of oil, which the high speed of the spindle naturally forces out under the whirl, a small ring, extending down a short distance into the bolster, is driven onto the spindle under the whirl. When starting up new spindles the oil chamber and tube should be completely filled, and afterwards, in order to get the best results, a little fresh oil should be added every week. An examination of the accompanying cut shows that the oil is admitted to spindle bearings through two small ducts. Thus the main supply of oil is not agitated by the motion of the spindle, and all dirt settles at bottom of the bolster case. The spindle is ordinarily built to drive the bobbin from a cone at the base of the spindle blade, and by this method of driving, the interior of the bobbin is not materially cut away, and its strength is maintained. The same spindle can be used for either warp or filling yarn, a convenience which will be appreciated by those whose work calls for frequent changes. The superiority of the Gravity Spindle in running is largely due to the arrangement of the parts of the bolster and its case opposite the center of the whirl. A sliding fit between the interior and exterior cylindrical surfaces of the bolster case and bolster respectively, allows the foot of the bolster sufficient play to obviate any tendency to gyrate. Thus it will be seen that with these surfaces arranged as described, and with the band pull at or near the middle of the same, the spindle is kept in a vertical position at all times, as the power of the band is exerted to bring these cylindrical surfaces in alignment, even when the unbalanced load tends to throw the bottom of the bolster out of its central relation. Thus the spindle remains true with the ring; the band pull does not deflect the spindles, whether tight or loose; and no influence is felt on the spinning of yarn by it. The position of the whirl is such that an even pressure is exerted upon the whole length of the spindle bearing. The spindle is elegant in design and finish, and is of the best workmanship throughout. The Gravity Spindle is made in six different sizes, a table of which is appended.

The Doffer Guard, or latch, as it may be called, consists of a combined spindle-stop and oil-cover firmly pivoted to the oil-tube in such a manner that the spindle when dropped into the bolster is locked automatically without the use of a wrench or other device required in the case of the ordinary restraining wire. It will be seen, however, that the spindle can be removed only by tilting the latch until the spindle is released from the stop, a thing which cannot occur in the ordinary process of doffing.

The following facts we believe will appeal most strongly to spinners:

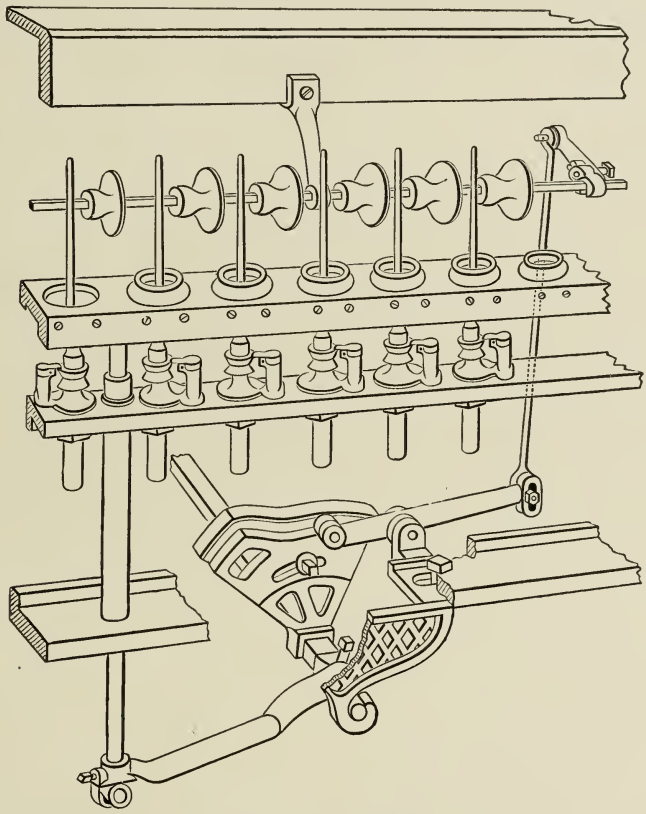
1st. The spindles may be oiled without waste from the front of the Frame while running, and the condition of the oil in the reservoirs be ascertained at any time by the overseer quickly, conveniently, and without previous preparation.

2nd. The oil reservoir is always effectively covered, preventing entrance of lint and dust, and avoiding the possibility of oil-stained yarn.

3rd. No wrench is required to remove spindles for inspection. Reference to the accompanying cut will render the foregoing description easily understood.

Weights of the Whitin Gravity Spindle.

Kind of Spindle.		Dia. of Whirl.	Weight.
Standard	Gravity Spinning Spindle,	$\frac{3}{4}$ in.	$4\frac{1}{2}$ oz.
Medium	Gravity Spinning Spindle,	$1\frac{3}{16}$ or $\frac{7}{8}$ in.	6 oz.
Large	Gravity Spinning Spindle,	$\frac{7}{8}$ in.	8 oz.
Water	Gravity Twisting Spindle,	$\frac{7}{8}$ in.	$9\frac{1}{2}$ oz.
Heavy	Gravity Twisting Spindle,	$1\frac{5}{16}$ in.	13 oz.
Ex. Heavy	Gravity Twisting Spindle,	$1\frac{5}{16}$ in.	15 oz.

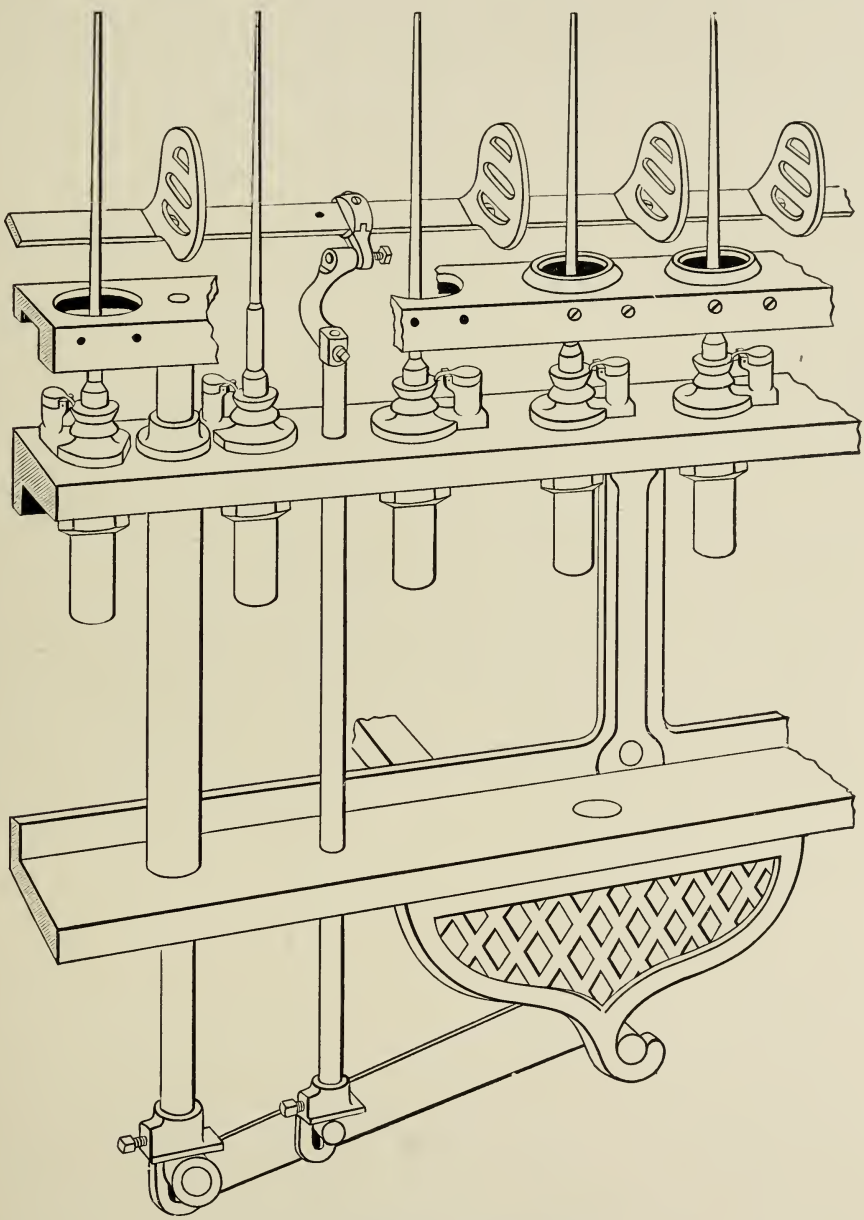


AUTOMATIC SEPARATOR.

New Model

No. 3 Automatic Separator.

It will be seen from the accompanying illustration, that the cam governing the motion of the blades in the modified form of our Automatic Separator, is now applied to one of the cross shafts of the frame instead of to the sleeve of the ordinary heart controlling the rail traverse. It will be noted that the cam-follower on the short end of the lever moves in a path defined by flanges on the face of the cam. By this arrangement the separator blades are moved forward to their position to prevent ballooning, and are also lifted out of the path of the ring rail, positively, and are not allowed to fall back by gravity as in the old style. This device makes it possible to balance the blades perfectly, and not leave an over-balance to carry them into working position by gravity, and insures the utmost lightness and ease of working the blades over their path. The blades are turned back for doffing by means of a patented separable clutch, which operates automatically when the blades are lifted against the actuating mechanism. The whole mechanisn is much simpler than the former pattern, is easily operated and readily understood, and is conveniently located. Either cast or stamped blades may be used. The separator can be readily applied to old frames.



NO. 4 AUTOMATIC SEPARATOR.

New Model

No. 4 Automatic Separator.

This form of Separator is designed for use on frames having a long traverse. The blades are made of stamped steel, combining strength with lightness. The rod on which the blades are fastened is also of steel, and is raised up and down in its path by auxiliary lifting rods resting upon a second set of rolls fastened to the arms of the regular cross shafts. The rod on which the blades are fastened is also jointed to the lifting rods, so that the blades may be conveniently and quickly turned back out of the way when doffing. A simple device is also provided which automatically restores the blades to their working position after doffing should the operator neglect to do so. As will be seen from the cut, the whole device is simple and readily adjusted.

Table of
Draughts of Ring Spinning Frames.

Diameter of { Front Roll, 1 in. / Back Roll, 7/8 in.

Front Roll Gear, 28 T.
Back Roll Gear, 84 T.
Gear on Stud, 84 T.

Change on Stud.	Draught.
26 T	11.077
28	10.286
30	9.600
32	9.000
34	8.470
36	8.000
38	7.579
40	7.200
42	6.857
44	6.545
46	6.261
48	6.000
50	5.760
52	5.538
54	5.333
56	5.143
58	4.965

Diameter of { Front Roll, 1 in. / Back Roll, 7/8 in.

Front Roll Gear, 30 T.
Back Roll Gear, 84.
Gear on Stud, 84.

Change on Stud.	Draught.
26 T	10.338
28	9.600
30	8.960
32	8.400
34	7.906
36	7.467
38	7.074
40	6.720
42	6.400
44	6.109
46	5.843
48	5.600
50	5.376
52	5.169
54	4.978
56	4.800
58	4.634

Diameter of { Front Roll, 1 in. / Back Roll, 7/8 in.

Front Roll Gear, 30 T.
Back Roll Gear, 84 T.
Gear on Stud, 168 T.

Change on Stud.	Draught.
30 T	17.920
32	16.800
34	15.812
36	14.933
38	14.147
41	13.112
44	12.218
47	11.438
50	10.752
53	10.143
56	9.600
59	9.112
62	8.671
67	8.024
72	7.467
77	6.982
82	6.556

Diameter of { Front Roll, 1 in. / Back Roll, 7/8 in.

Front Roll Gear, 30 T.
Back Roll Gear, 84 T.
Gear on Stud, 60 T.

Change on Stud.	Draught.
26 T	7.385
27	7.111
28	6.857
29	6.621
30	6.400
31	6.193
32	6.000
33	5.818
34	5.647
35	5.486
36	5.333
37	5.189
38	5.053
39	4.923
40	4.800
41	4.683
42	4.571

Draught Tables of Ring Spinning Frame.

DIAMETER OF { FRONT ROLL, 1 INCH. / BACK ROLL, $\frac{7}{8}$ INCH.

Front Roll Gear, 30 T. Back Roll Gear, 84 T. Gear on Stud, 120 T.

Change on Stud.	Draught.	Change on Stud.	Draught.
26 Teeth.	14.770	39 Teeth.	9.846
27 "	14.222	40 "	9.600
28 "	13.715	41 "	9.366
29 "	13.241	42 "	9.143
30 "	12.800	43 "	8.930
31 "	12.387	45 "	8.533
32 "	12.000	48 "	8.000
33 "	11.636	50 "	7.680
34 "	11.294	52 "	7.385
35 "	10.971	54 "	7.111
36 "	10.666	56 "	6.857
37 "	10.378	58 "	6.621
38 "	10.105	60 "	6.400

Ring Frame Change Twist Gear Tables.

Front Roll 1 in. Diameter.

Cyl. 6¼ in. dia. Whirl ¾ in. dia. Ratio of Cyl. to Whirl 1 to 7.44.				Cyl. 6¼ in. dia. Whirl ⅞ in. dia. Ratio of Cyl. to Whirl 1 to 6.47.			
Cyl. 22 T. Stud 88 T. Front Roll 108 T.		Cyl. 36 T. Stud 74 T. Front Roll 108 T.		Cyl. 22 T. Stud 88 T. Front Roll 108 T.		Cyl. 36 T. Stud 74 T. Front Roll 108 T.	
On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.
15 T	68.17	15 T	35.03	15 T	59.29	15 T	30.47
16	63.92	16	32.84	16	55.58	16	28.56
17	60.16	17	30.91	17	52.31	17	26.88
18	56.81	18	29.20	18	49.41	18	25.39
19	53.82	19	27.66	19	46.81	19	24.05
20	51.13	20	26.28	20	44.47	20	22.85
21	48.70	21	25.02	21	42.35	21	21.76
22	46.48	22	23.89	22	40.42	22	20.77
23	44.46	23	22.85	23	38.67	23	19.87
24	42.61	24	21.90	24	37.05	24	19.04
25	40.91	25	21.02	25	35.57	25	18.28
26	39.33	26	20.21	26	34.20	26	17.58
27	37.88	27	19.46	27	32.94	27	16.93
28	36.52	28	18.77	28	31.76	28	16.32
29	35.26	29	18.12	29	30.67	29	15.76
30	34.09	30	17.52	30	29.64	30	15.23
31	32.99	31	16.95	31	28.69	31	14.74
32	31.96	32	16.42	32	27.79	32	14.28
33	30.99	33	15.92	33	26.95	33	13.85
34	30.08	34	15.45	34	26.16	34	13.44
35	29.22	35	15.01	35	25.41	35	13.06
36	28.41	36	14.60	36	24.70	36	12.69
37	27.64	37	14.20	37	24.03	37	12.35
38	26.91	38	13.82	38	23.40	38	12.03
39	26.22	39	13.47	39	22.80	39	11.72
40	25.57	40	13.14	40	22.23	40	11.42
41	24.94	41	12.82	41	21.69	41	11.15
42	24.35	42	12.51	42	21.17	42	10.88
43	23.78	43	12.22	43	20.68	43	10.63
44	23.24	44	11.94	44	20.21	44	10.39
45	22.72	45	11.68	45	19.76	45	10.16
46	22.23	46	11.42	46	19.33	46	9.93
47	21.76	47	11.18	47	18.92	47	9.72
48	21.30	48	10.95	48	18.52	48	9.52
50	20.45	50	10.51	50	17.79	50	9.14
52	19.67	52	10.11	52	17.10	52	8.79
54	18.94	54	9.73	54	16.47	54	8.46
56	18.26	56	9.38	56	15.88	56	8.16
58	17.63	58	9.06	58	15.33	58	7.88
60	17.04	60	8.76	60	14.82	60	7.62

Ring Frame Change Twist Gear Tables.

Front Roll 1 in. Diameter.

Cyl. 7 in. dia. Whirl ¾ in. dia. Ratio of Cyl. to Whirl 1 to 8.33.				Cyl. 7 in. dia. Whirl ⅞ in. dia. Ratio of Cyl. to Whirl 1 to 7.25.			
Cyl. 22 T. Stud 88 T. Front Roll 108 T.		Cyl. 36 T. Stud 74 T. Front Roll 108 T.		Cyl. 22 T. Stud 88 T. Front Roll 108 T.		Cyl. 36 T. Stud 74 T. Front Roll 108 T.	
On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.
15 T	76.33	15 T	39.23	15 T	66.44	15 T	34.14
16	71.56	16	36.77	16	62.28	16	32.00
17	67.35	17	34.61	17	58.62	17	30.12
18	63.61	18	32.69	18	55.36	18	28.45
19	60.26	19	30.97	19	52.45	19	26.95
20	57.25	20	29.42	20	49.83	20	25.60
21	54.52	21	28.02	21	47.45	21	24.39
22	52.04	22	26.74	22	45.30	22	23.28
23	49.78	23	25.58	23	43.33	23	22.26
24	47.71	24	24.52	24	41.52	24	21.33
25	45.80	25	23.54	25	39.86	25	20.48
26	44.04	26	22.63	26	38.32	26	19.70
27	42.41	27	21.79	27	36.91	27	18.97
28	40.89	28	21.01	28	35.59	28	18.29
29	39.48	29	20.29	29	34.36	29	17.66
30	38.17	30	19.61	30	33.22	30	17.07
31	36.93	31	18.98	31	32.15	31	16.52
32	35.78	32	18.39	32	31.14	32	16.00
33	34.70	33	17.83	33	30.20	33	15.52
34	33.68	34	17.30	34	29.31	34	15.06
35	32.71	35	16.81	35	28.47	35	14.63
36	31.80	36	16.34	36	27.68	36	14.22
37	30.94	37	15.90	37	26.93	37	13.84
38	30.13	38	15.48	38	26.22	38	13.48
39	29.36	39	15.08	39	25.55	39	13.13
40	28.62	40	14.71	40	24.91	40	12.80
41	27.93	41	14.35	41	24.30	41	12.49
42	27.26	42	14.00	42	23.73	42	12.19
43	26.63	43	13.68	43	23.17	43	11.91
44	26.02	44	13.37	44	22.65	44	11.64
45	25.44	45	13.07	45	22.14	45	11.38
46	24.89	46	12.79	46	21.66	46	11.13
47	24.36	47	12.52	47	21.20	47	10.89
48	23.85	48	12.26	48	20.76	48	10.67
50	22.90	50	11.77	50	19.93	50	10.24
52	22.02	52	11.31	52	19.16	52	9.85
54	21.20	54	10.90	54	18.45	54	9.48
56	20.45	56	10.51	56	17.79	56	9.14
58	19.74	58	10.14	58	17.18	58	8.83
60	19.08	60	9.81	60	16.61	60	8.53

Ring Frame Change Twist Gear Tables.

Front Roll 1 in. Diameter.

Cyl. 8 in. dia. Whirl ¾ in. dia. Ratio of Cyl. to Whirl 1 to 9.52.				Cyl. 8 in. dia. Whirl ⅞ in. dia. Ratio of Cyl. to Whirl 1 to 8.28.			
Cyl. 22 T. Stud 88 T. Front Roll 108 T.		Cyl. 36 T. Stud 74 T. Front Roll 108 T.		Cyl. 22 T. Stud 88 T. Front Roll 108 T.		Cyl. 36 T. Stud 74 T. Front Roll 108 T.	
On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.
15 T	87.24	15 T	44.83	15 T	75.87	15 T	38.99
16	81.78	16	42.03	16	71.13	16	36.55
17	76.97	17	39.56	17	66.95	17	34.40
18	72.70	18	37.36	18	63.23	18	32.49
19	68.87	19	35.39	19	59.90	19	30.78
20	65.43	20	33.62	20	56.91	20	29.24
21	62.31	21	32.02	21	54.20	21	27.85
22	59.48	22	30.56	22	51.73	22	26.58
23	56.89	23	29.23	23	49.48	23	25.42
24	54.52	24	28.02	24	47.42	24	24.37
25	52.34	25	26.90	25	45.52	25	23.39
26	50.33	26	25.86	26	43.77	26	22.49
27	48.46	27	24.90	27	42.15	27	21.66
28	46.73	28	24.01	28	40.65	28	20.89
29	45.12	29	23.19	29	39.24	29	20.17
30	43.62	30	22.41	30	37.94	30	19.49
31	42.21	31	21.69	31	36.71	31	18.87
32	48.89	32	21.01	32	35.57	32	18.28
33	39.65	33	20.38	33	34.49	33	17.72
34	38.49	34	19.78	34	33.47	34	17.20
35	37.39	35	19.21	35	32.52	35	16.71
36	36.35	36	18.68	36	31.61	36	16.24
37	35.37	37	18.17	37	30.76	37	15.81
38	34.44	38	17.69	38	29.95	38	15.39
39	33.55	39	17.24	39	29.18	39	15.00
40	32.71	40	16.81	40	28.45	40	14.62
41	31.91	41	16.40	41	27.76	41	14.26
42	31.16	42	16.01	42	27.10	42	13.92
43	30.43	43	15.64	43	26.47	43	13.60
44	29.74	44	15.28	44	25.87	44	13.29
45	29.08	45	14.94	45	25.29	45	13.00
46	28.45	46	14.62	46	24.74	46	12.71
47	27.84	47	14.31	47	24.21	47	12.44
48	27.26	48	14.01	48	23.71	48	12.18
50	26.17	50	13.45	50	22.76	50	11.70
52	25.16	52	12.93	52	21.89	52	11.25
54	24.23	54	12.45	54	21.08	54	10.83
56	23.37	56	12.01	56	20.32	56	10.44
58	22.56	58	11.59	58	19.62	58	10.08
60	21.81	60	11.21	60	18.97	60	9.75

Ring Frame Change Twist Gear Tables.

Front Roll 1 in. Diameter.

Cyl. 6¼ in. dia., Whirl ¾ in. dia.		Cyl. 6¼ in. dia. Whirl ⅞ in. dia.		Cyl. 7 in. dia. Whirl ¾ in. dia.	
Cyl. : Whirl : : 1 : 7.44.		Cyl. : Whirl : : 1 : 6.47.		Cyl. : Whirl : : 1 : 8.33	
Cyl. 55 T., Stud 55 T.		Cyl. 55 T., Stud 55 T.		Cyl. 55 T., Stud 55 T.	
Front Roll 108 T.		Front Roll 108 T.		Front Roll 108 T.	
On Stud.	Twist.	On Stud.	Twist.	On Stud	Twist.
15 Teeth.	17.04	15 Teeth.	14.82	15 Teeth.	19.08
16 "	15.98	16 "	13.89	16 "	17.89
17 "	15.04	17 "	13.08	17 "	16.84
18 "	14.20	18 "	12.35	18 "	15.90
19 "	13.45	19 "	11.70	19 "	15.07
20 "	12.78	20 "	11.12	20 "	14.31
21 "	12.17	21 "	10.59	21 "	13.63
22 "	11.62	22 "	10.10	22 "	13.01
23 "	11.12	23 "	9.67	23 "	12.45
24 "	10.65	24 "	9.26	24 "	11.93
25 "	10.23	25 "	8.89	25 "	11.45
26 "	9.83	26 "	8.55	26 "	11.01
27 "	9.47	27 "	8.23	27 "	10.60
28 "	9.13	28 "	7.94	28 "	10.22
29 "	8.82	29 "	7.67	29 "	9.87
30 "	8.52	30 "	7.41	30 "	9.54
31 "	8.25	31 "	7.17	31 "	9.23
32 "	7.99	32 "	6.95	32 "	8.95
33 "	7.75	33 "	6.74	33 "	8.67
34 "	7.52	34 "	6.54	34 "	8.42
35 "	7.30	35 "	6.35	35 "	8.18
36 "	7.10	36 "	6.16	36 "	7.95
37 "	6.91	37 "	6.01	37 "	7.74
38 "	6.73	38 "	5.85	38 "	7.54
39 "	6.56	39 "	5.70	39 "	7.34
40 "	6.39	40 "	5.56	40 "	7.16
41 "	6.24	41 "	5.42	41 "	6.98
42 "	6.09	42 "	5.29	42 "	6.82
43 "	5.94	43 "	5.17	43 "	6.66
44 "	5.81	44 "	5.05	44 "	6.51
45 "	5.68	45 "	4.94	45 "	6.36
46 "	5.56	46 "	4.84	46 "	6.22
47 "	5.44	47 "	4.73	47 "	6.09
48 "	5.32	48 "	4.63	48 "	5.97
50 "	5.11	50 "	4.45	50 "	5.72
52 "	4.92	52 "	4.28	52 "	5.50
54 "	4.73	54 "	4.12	54 "	5.30
56 "	4.56	56 "	3.97	56 "	5.11
58 "	4.41	58 "	3.83	58 "	4.93
60 "	4.26	60 "	3.70	60 "	4.77

Ring Frame Change Twist Gear Tables.

Front Roll 1 in. Diameter.

Cyl. 7 in. dia., Whirl $\frac{7}{8}$ in. dia		Cyl. 8 in. dia. Whirl $\frac{3}{4}$ in. dia.		Cyl. 8 in. dia. Whirl $\frac{7}{8}$ in. dia.	
Cyl. : Whirl : : 1 : 7.25.		Cyl. : Whirl : : 1 : 9.52.		Cyl. : Whirl : : 1 : 8.28	
Cyl. 55 T., Stud 55 T.		Cyl. 55 T., Stud 55 T.		Cyl. 55 T., Stud 55 T.	
Front Roll 108 T.		Front Roll 108 T.		Front Roll 108 T.	
On Stud.	Twist.	On Stud.	Twist.	On Stud	Twist.
15 Teeth.	16.61	15 Teeth.	21.81	15 Teeth.	18.97
16 "	15.57	16 "	20.45	16 "	17.78
17 "	14.65	17 "	19.24	17 "	16.74
18 "	13.84	18 "	18.17	18 "	15.81
19 "	13.11	19 "	17.22	19 "	14.97
20 "	12.46	20 "	16.36	20 "	14.22
21 "	11.86	21 "	15.58	21 "	13.55
22 "	11.32	22 "	14.87	22 "	12.93
23 "	10.83	23 "	14.22	23 "	12.37
24 "	10.38	24 "	13.63	24 "	11.86
25 "	9.97	25 "	13.08	25 "	11.38
26 "	9.58	26 "	12.58	26 "	10.94
27 "	9.23	27 "	12.12	27 "	10.54
28 "	8.89	28 "	11.68	28 "	10.16
29 "	8.59	29 "	11.28	29 "	9.81
30 "	8.30	30 "	10.90	30 "	9.48
31 "	8.04	31 "	10.55	31 "	9.18
32 "	7.78	32 "	10.22	32 "	8.89
33 "	7.55	33 "	9.91	33 "	8.62
34 "	7.33	34 "	9.62	34 "	8.37
35 "	7.12	35 "	9.35	35 "	8.13
36 "	6.92	36 "	9.09	36 "	7.90
37 "	6.73	37 "	8.84	37 "	7.69
38 "	6.55	38 "	8.60	38 "	7.49
39 "	6.38	39 "	8.38	39 "	7.29
40 "	6.23	40 "	8.18	40 "	7.11
41 "	6.08	41 "	7.98	41 "	6.94
42 "	5.93	42 "	7.79	42 "	6.77
43 "	5.80	43 "	7.61	43 "	6.62
44 "	5.66	44 "	7.43	44 "	6.47
45 "	5.53	45 "	7.27	45 "	6.32
46 "	5.42	46 "	7.11	46 "	6.18
47 "	5.30	47 "	6.96	47 "	6.05
48 "	5.19	48 "	6.81	48 "	5.93
50 "	4.98	50 "	6.54	50 "	5.69
52 "	4.79	52 "	6.29	52 "	5.47
54 "	4.62	54 "	6.06	54 "	5.27
56 "	4.45	56 "	5.84	56 "	5.08
58 "	4.29	58 "	5.64	58 "	4.91
60 "	4.15	60 "	5.45	60 "	4.74

Ring Frame Change Twist Gear Tables.

Front Roll 1 in. Diameter.

Cylinder 7 in. diameter. Whirl $\frac{13}{16}$ in. diameter. Cylinder : Whirl : : 1 : 7.68.

Front Roll Gear 108 Teeth.

Cylinder 22 T., Stud 88 T.		Cylinder 36 T. Stud 74 T.		Cylinder 55 T., Stud 55 T.	
On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.
15 Teeth.	70.37	15 Teeth.	36.17	15 Teeth.	17.60
16 "	65.98	16 "	33.91	16 "	16.50
17 "	62.09	17 "	31.91	17 "	15.52
18 "	58.65	18 "	30.14	18 "	14.66
19 "	55.56	19 "	28.55	19 "	13.89
20 "	52.78	20 "	27.12	20 "	13.20
21 "	50.27	21 "	25.83	21 "	12.57
22 "	47.98	22 "	24.66	22 "	12.00
23 "	45.89	23 "	23.59	23 "	11.50
24 "	43.98	24 "	22.60	24 "	11.00
25 "	42.23	25 "	21.70	25 "	10.56
26 "	40.60	26 "	20.86	26 "	10.15
27 "	39.10	27 "	20.09	27 "	9.77
28 "	37.70	28 "	19.37	28 "	9.43
29 "	36.40	29 "	18.71	29 "	9.10
30 "	35.19	30 "	18.08	30 "	8.80
31 "	34.05	31 "	17.50	31 "	8.52
32 "	32.99	32 "	16.95	32 "	8.25
33 "	31.99	33 "	16.44	33 "	8.00
34 "	31.04	34 "	15.95	34 "	7.76
35 "	30.16	35 "	15.21	35 "	7.54
36 "	29.32	36 "	15.06	36 "	7.33
37 "	28.53	37 "	14.66	37 "	7.13
38 "	27.78	38 "	14.28	38 "	6.95
39 "	27.06	39 "	13.91	39 "	6.77
40 "	26.39	40 "	13.56	40 "	6.60
41 "	25.74	41 "	13.23	41 "	6.44
42 "	25.13	42 "	12.91	42 "	6.28
43 "	24.55	43 "	12.61	43 "	6.14
44 "	23.99	44 "	12.33	44 "	6.00
45 "	23.46	45 "	12.05	45 "	5.87
46 "	22.95	46 "	11.79	46 "	5.74
47 "	22.46	47 "	11.54	47 "	5.62
48 "	21.99	48 "	11.30	48 "	5.50
50 "	21.11	50 "	10.85	50 "	5.28
52 "	20.30	52 "	10.43	52 "	5.08
54 "	19.55	54 "	10.04	54 "	4.89
56 "	18.85	56 "	9.68	56 "	4.72
58 "	18.20	58 "	9.35	58 "	4.55
60 "	17.59	60 "	9.04	60 "	4.40

Ring Frame Change Twist Gear Tables.

Front Roll 1 in. Diameter.

Cylinder 8 in. diameter. Whirl $\frac{13}{16}$ in. diameter. Cylinder : Whirl : : 1 : 8.91.

Front Roll Gear 108 Teeth.

Cylinder 22 T., Stud 88 T.		Cylinder 36 T. Stud 74 T.		Cylinder 55 T., Stud 55 T.	
On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.
15 Teeth.	81.65	15 Teeth.	41.96	15 Teeth.	20.41
16 "	76.55	16 "	39.93	16 "	19.13
17 "	72.04	17 "	37.02	17 "	18.01
18 "	68.04	18 "	34.96	18 "	17.01
19 "	64.46	19 "	33.12	19 "	16.11
20 "	61.24	20 "	31.46	20 "	15.31
21 "	58.31	21 "	29.97	21 "	14.58
22 "	55.67	22 "	28.61	22 "	13.92
23 "	53.25	23 "	27.36	23 "	13.31
24 "	51.03	24 "	26.22	24 "	12.76
25 "	48.99	25 "	25.17	25 "	12.25
26 "	47.10	26 "	24.21	26 "	11.77
27 "	45.36	27 "	23.31	27 "	11.34
28 "	43.74	28 "	22.48	28 "	10.93
29 "	42.23	29 "	21.70	29 "	10.55
30 "	40.82	30 "	20.98	30 "	10.21
31 "	39.51	31 "	20.30	31 "	9.88
32 "	38.28	32 "	19.67	32 "	9.57
33 "	37.12	33 "	19.07	33 "	9.28
34 "	36.02	34 "	18.51	34 "	9.01
35 "	35.14	35 "	17.98	35 "	8.75
36 "	34.02	36 "	17.48	36 "	8.51
37 "	33.10	37 "	17.01	37 "	8.27
38 "	32.23	38 "	16.55	38 "	8.05
39 "	31.40	39 "	16.13	39 "	7.85
40 "	30.62	40 "	15.73	40 "	7.65
41 "	29.88	41 "	15.35	41 "	7.47
42 "	29.16	42 "	14.98	42 "	7.29
43 "	28.48	43 "	14.64	43 "	7.12
44 "	27.84	44 "	14.30	44 "	6.96
45 "	27.21	45 "	13.98	45 "	6.80
46 "	26.62	46 "	13.68	46 "	6.65
47 "	26.06	47 "	13.39	47 "	6.51
48 "	25.52	48 "	13.11	48 "	6.38
50 "	24.49	50 "	12.59	50 "	6.12
52 "	23.56	52 "	12.10	52 "	5.89
54 "	22.68	54 "	11.66	54 "	5.67
56 "	21.87	56 "	11.24	56 "	5.46
58 "	21.12	58 "	10.85	58 "	5.28
60 "	20.41	60 "	10.49	60 "	5.10

Production Table of Ring Warp Yarn.

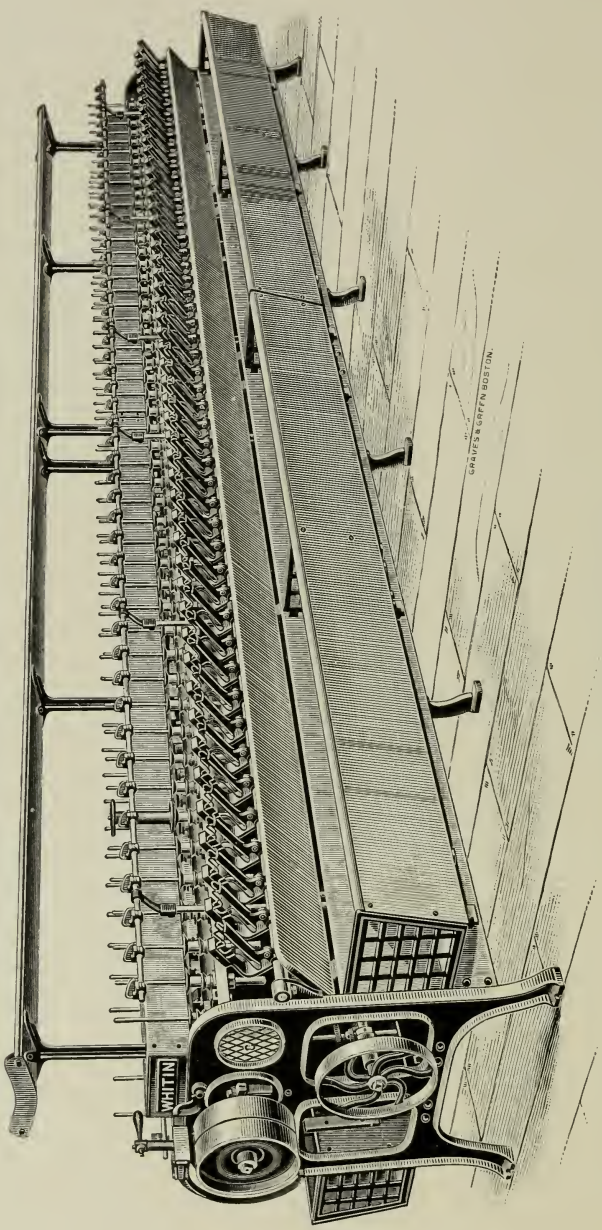
No. of Yarn.	Grains per Yard.	Twist per Inch.	Revolutions of Front Roll per Minute.	Revolutions of Spindle per Minute.	Hanks per Day per Spindle.	Pounds per Day per Spind e.	No. of Yarn.
4	2.080	9.50	154.0	4600	8.642	2.160	4
5	1.670	10.62	152.8	5100	8.575	1.715	5
6	1.389	11.63	150.4	5500	8.440	1.407	6
7	1.190	12.56	149.5	5900	8.389	1.198	7
8	1.042	13.43	149.9	6300	8.412	1.051	8
9	.926	14.25	147.4	6600	8.272	.919	9
10	.833	15.02	146.2	6900	8.295	.829	10
11	.757	15.75	143.4	7100	8.136	.740	11
12	.694	16.45	143.2	7400	8.214	.685	12
13	.641	17.12	141.3	7600	8.105	.623	13
14	.595	17.77	139.7	7800	8.013	.572	14
15	.555	18.39	138.4	8000	7.938	.529	15
16	.521	19.00	137.3	8200	7.875	.492	16
17	.490	19.58	134.8	8300	7.732	.455	17
18	.463	20.15	134.2	8500	7.698	.428	18
19	.438	20.70	132.2	8600	7.582	.399	19
20	.417	21.24	131.8	8800	7.560	.378	20
21	.397	21.76	130.1	8900	7.462	.355	21
22	.379	22.27	128.6	9000	7.376	.335	22
23	.362	22.78	125.7	9000	7.210	.314	23
24	.347	23.27	124.5	9100	7.141	.298	24
25	.333	23.75	123.2	9200	7.067	.283	25
26	.320	24.22	122.2	9300	7.085	.272	26
27	.308	24.68	119.9	9300	6.952	.258	27
28	.297	25.13	117.8	9300	6.830	.244	28
29	.287	25.58	116.9	9400	6.778	.233	29
30	.277	26.02	115.0	9400	6.668	.223	30
31	.269	26.44	113.1	9400	6.557	.212	31
32	.260	26.87	112.4	9500	6.516	.205	32
33	.252	27.28	110.8	9500	6.425	.195	33
34	.245	27.69	109.1	9500	6.326	.186	34
35	.238	28.10	107.6	9500	6.306	.180	35
36	.231	28.50	106.1	9500	6.218	.173	36
37	.225	28.89	104.6	9500	6.131	.166	37
38	.219	29.28	103.2	9500	6.048	.159	38
39	.213	29.66	101.9	9500	5.972	.153	39
40	.208	30.04	100.6	9500	5.896	.147	40
41	.203	30.42	99.3	9500	5.820	.142	41
42	.198	30.78	98.2	9500	5.755	.137	42
43	.194	31.14	97.1	9500	5.691	.132	43
44	.189	31.50	96.0	9500	5.626	.128	44
45	.185	31.86	94.8	9500	5.615	.125	45
46	.181	32.21	93.8	9500	5.556	.121	46
47	.177	32.56	92.8	9500	5.496	.117	47
48	.174	32.90	91.9	9500	5.443	.113	48
49	.170	33.25	90.9	9500	5.384	.110	49
50	.166	33.58	90.9	9600	5.384	.108	50
55	.151	35.22	86.7	9600	5·189	.0943	55
60	.138	36.79	84.7	9800	5.070	.0845	60
65	.128	38.30	81.4	9800	4.872	.0750	65
70	.119	39.74	77.7	9700	4.651	.0665	70
75	.111	41.14	74.2	9600	4.442	.0592	75
80	.104	42.48	70.4	9400	4.214	.0527	80
85	.098	43.79	66.9	9200	4.005	.0471	85
90	.092	45.06	63.5	9000	3.841	.0427	90
95	.088	46.30	60.5	8800	3.659	.0385	95
100	.083	47.50	57.6	8600	3.519	.0352	100

Allowance has been made for cleaning, oiling, and doffing.

Production Table of Ring Filling Yarn.

No. of Yarn.	Grains per Yard.	Twist per Inch.	Revolutions of Front Roll per Minute.	Revolutions of Spindle per Minute.	Hanks per Day per Spindle.	Pounds per Day per Spindle.	No. of Yards.
4	2.080	6.50	176.5	3600	9.573	2.393	4
5	1.670	7.27	175.0	4000	9.492	1.898	5
6	1.389	7.96	171.4	4300	9.405	1.567	6
7	1.190	8.60	168.3	4550	9.235	1.319	7
8	1.042	9.19	166.2	4800	9.119	1.139	8
9	.926	9.75	163.2	5000	8.955	.995	9
10	.833	10.27	161.2	5200	8.945	.894	10
11	.757	10.78	159.4	5400	8.845	.804	11
12	.694	11.26	158.2	5600	8.778	.731	12
13	.641	11.72	157.4	5800	8.734	.672	13
14	.595	12.16	156.9	6000	8.706	.622	14
15	.555	12.59	156.7	6200	8.792	.586	15
16	.521	13.00	155.4	6350	8.719	.545	16
17	.490	13.40	153.1	6500	8.590	.506	17
18	.463	13.79	152.2	6600	8.540	.476	18
19	.438	14.17	150.4	6700	8.439	.444	19
20	.417	14.53	148.8	6800	8.444	.422	20
21	.397	14.89	147.3	6900	8.358	.398	21
22	.379	15.24	146.1	7000	8.290	.376	22
23	.362	15.59	142.8	7000	8.102	.352	23
24	.347	15.92	139.9	7000	7.938	.331	24
25	.333	16.25	139.0	7100	7.887	.315	25
26	.320	16.57	138.2	7200	7.927	.305	26
27	.308	16.89	135.6	7200	7.778	.288	27
28	.297	17.20	134.1	7250	7.692	.275	28
29	.287	17.50	131.8	7250	7.560	.259	29
30	.277	17.80	129.6	7250	7.514	.250	30
31	.269	18.10	128.3	7300	7.439	.240	31
32	.260	18.38	126.3	7300	7.323	.229	32
33	.252	18.67	124.4	7300	7.213	.219	33
34	.245	18.95	122.4	7300	7.097	.208	34
35	.238	19.23	120.8	7300	7.080	.202	35
36	.231	19.50	119.1	7300	6.980	.194	36
37	.225	19.77	118.2	7350	6.928	.187	37
38	.219	20.03	117.6	7400	6.892	.181	38
39	.213	20.30	116.0	7400	6.799	.174	39
40	.208	20.55	115.4	7450	6.835	.171	40
41	.203	20.81	114.7	7500	6.793	.166	41
42	.198	21.06	113.3	7500	6.711	.160	42
43	.194	21.31	111.9	7500	6.628	.154	43
44	.189	21.56	110.7	7500	6.557	.149	44
45	.185	21.80	109.4	7500	6.480	.144	45
46	.181	22.04	108.3	7500	6.414	.139	46
47	.177	22.28	107.1	7500	6.343	.135	47
48	.174	22.52	105.9	7500	6.272	.131	48
49	.170	22.75	104.9	7500	6.213	.127	49
50	.166	22.98	103.9	7500	6.218	.124	50
52	.160	23.44	103.1	7600	6.170	.119	52
54	.154	23.88	101.3	7600	6.063	.112	54
56	.149	24.32	99.4	7600	6.018	.107	56
58	.143	24.75	97.7	7600	5.909	.102	58
60	.138	25.16	96.1	7600	5.872	.098	60
65	.128	26.20	92.3	7700	5.639	.087	65
70	.119	27.19	88.9	7600	5.432	.077	70
75	.111	28.14	83.8	7400	5.120	.068	75
80	.104	29.07	78.8	7200	4.815	.060	80
85	.098	29.96	74.3	7000	4.540	.053	85

Allowance has been made for cleaning, oiling, and doffing.



UPRIGHT SPOOLER.

Upright Spooler.

The accompanying cut shows clearly the general features of construction of our new Spooler. The chief departures from our former pattern are the adoption of the single rail for holding the spindle, and the entire remodelling of the spindle itself. The latter runs in a bolster with closed bottom, and being held by the single rail, is always found to run freely, any twisting or settling of the frame not affecting the spindle, as sometimes happens when two rails are used. The bolster case, between the spindle bearings at the extreme top and bottom, is enlarged to form a chamber holding a considerable quantity of oil. The spindle is further constructed so that all oil is thrown off before reaching the top of the bolster, and is then conducted back by channels to the oil chamber, thus avoiding waste. The spindle virtually runs in a bottle, and a little oil once in a month or two will be found sufficient, there being no waste except by evaporation.

To avoid cross-banding at the end of the cylinder, two spindles are equipped with double whirls, driving from one to the other.

The single rail supporting the spindles is made extra strong and heavy. Our new patent Thread Guide has the horizontal slot and is easily adjusted both for height and different opening of slot. Either adjustment is independent of the other, so that in changing, attention need be given only to the defective point. The guide is further arranged so that the slot will not be closed by an accidental blow, as from a spool. We equip the spooler with either the Wade type of bobbin holders, or side spindles as desired. The bobbin boxes are of large capacity, and are fitted with shields to keep out dirt falling from above, or we apply brackets to receive the ordinary doffing boxes as they come from the spinning room. The wave or traverse is governed by a mangle, and on long machines is driven from both ends, thus ensuring a very positive and steady motion to the guides the whole length of the frame, and guaranteeing perfect spools. The wave shaft is placed high in the frame, so that the levers operating the lifting-rods are well up from the mill floor. This prevents the breakage of the mangle by the levers striking any stray spools that may have fallen under the frame. Creel and trough are made conveniently for storing empty and full spools. The driving pulley is provided with shipper-fork for both overhead and underneath belts.

Floor Space:—Width 4 ft. 9 in., and lengths as follows:

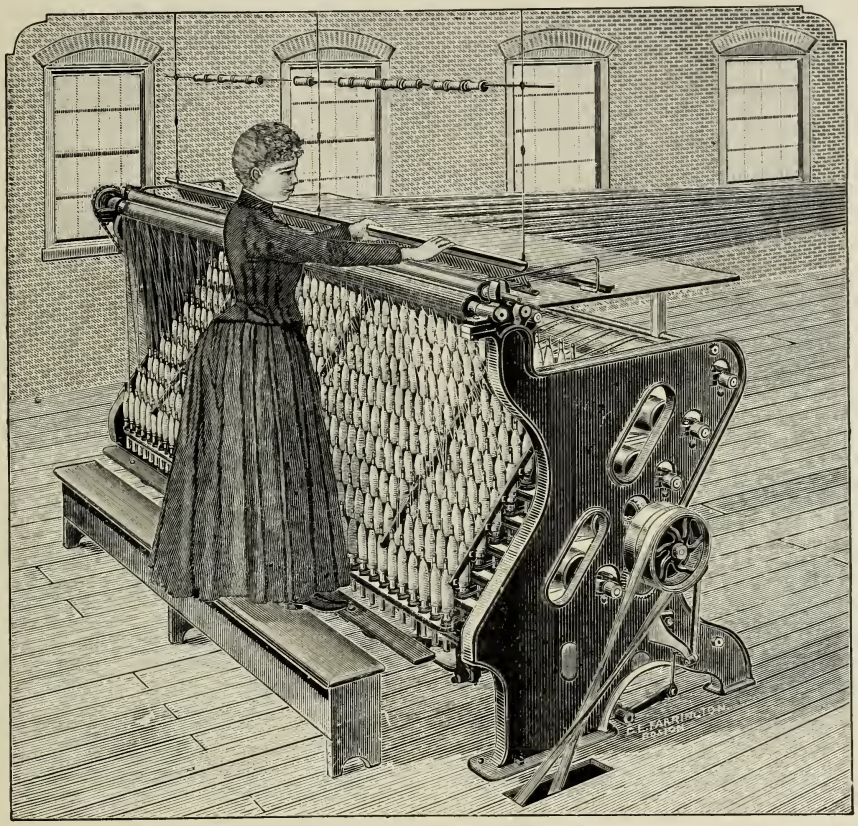
No. of Spindles.	3½ in. Space.		3¾ in. Space.		4 in. Space.		4¼ in. Space.		4½ in. Space.		4¾ in. Space.		5 in. Space.		5½ in. Space.		6 in. Space.	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
40	6	9¾	7	2½	7	7¼	8	0	8	4¾	8	10½	9	3¼	9	8	10	0¾
60	9	8¾	10	4	10	11¼	11	6½	12	1¾	12	10	13	5¼	14	7¾	15	10¼
80	12	7¾	13	5½	14	3¼	15	1	15	10¾	16	9½	17	7¼	19	2¾	20	10¼
100	15	6¾	16	7	17	7¼	18	7½	19	7¾	20	9	21	9¼	23	9¾	25	10¼
120	18	5¾	19	8½	20	11¼	22	2	23	4¾	24	8½	25	11¼	28	4¾	30	10¼

The lengths given are outside of driving pulleys.

Driving Pulleys are 10 in. and 12 in. diameter, 2½ in. face, and run from 160 to 260 revolutions per minute.

Production Table of Spooler.

Dimensions of Spools.		Number of Yarn.	Revolutions per Minute of			No. Whitin Gravity Spindles to one Spooler Spindle at 825 Rev.
Length between Heads.	Diameter of Heads.		Cyl. 178, Spindle 750	Cyl. 196, Spindle 825	Cyl. 214, Spindle 900	
			Pounds per Day per Spindle.			
		8	10.8	11.8	12.9	
		10	8.6	9.5	10.3	12
6in.	5 in.	12	7.2	7.9	8.6	
		14	6.2	6.8	7.4	
		16	5.4	5.9	6.5	13
		18	4.8	5.3	5.8	
		20	4.3	4.8	5.2	
		22	3.9	4.3	4.7	14
		24	3.6	4.0	4.3	
5 in.	4 in.	26	3.3	3.7	4.0	
		28	3.1	3.4	3.7	15
		30	2.9	3.2	3.5	
		32	2.7	3.0	3.3	16
		34	2.6	2.8	3.1	
		36	2.4	2.7	2.9	17
		38	2.3	2.5	2.7	
$4\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	40	2.2	2.4	2.6	18
		44	2.0	2.2	2.4	19
		50	1.8	1.9	2.1	20
		60	1.5	1.6	1.8	21
$3\frac{1}{2}$ in.	$3\frac{1}{4}$ in.	70	1.3	1.4	1.5	23
		80	1.1	1.2	1.3	25
3 in.	$2\frac{3}{4}$ in.	90	1.0	1.1	1.2	27
		100	.9	1.0	1.1	30



Long Chain Quilling Machine.

In preparing yarn for colored goods, the advantages gained by the chain system of dyeing, over the skein, are so many, both in the line of economy as well as in the better quality of the yarn produced, it is evident that some good method whereby the yarn which has already been dyed or bleached in the chain could be directly put on to quills or bobbins ready for weaving, must present itself favorably to the attention of all manufacturers of colored goods.

To accomplish this, the machine shown in the accompanying cut, has been constructed. The chain of yarn, that comes to the machine from the dry cans or dry room, is placed on a turn table and passed over friction drums, same as in ordinary chain beaming, the balance of the method is easily understood as shown by the cut. The whole operation being similar to beaming.

The machine is very simple, and easily operated by girls. Any ordinary size quill or bobbin can be used; those generally used contain 1800 yards of No. 28 yarn and 2000 yards of No. 33 yarn.

The building motion on machine has a quick return which securely binds the yarn on to the quill, thereby forming a very solid and compact bobbin. "Lapped ends" cannot be made, consequently bobbins will weave from start to finish without break of yarn, and also without leaving any waste on bobbin.

The yarn does not come in contact with any friction, thus burnishing and burning or changing of color is prevented, which is a cause of so much complaint on the old method of quilling, colors being left bright and clear as originally dyed.

Capacity of machine is about the same as ordinary chain beaming.

Shipper motion is operated by the foot of the operator, leaving both hands free. Machine is also provided with a "slow motion." Each machine has 378 spindles. Method of doffing same as on mules, yarn being depressed below bottom of quill or bobbin and then wound on bare spindle. Time consumed doffing and starting new set of bobbins, eight to ten minutes. Two machines can be placed in one eight foot bay of a mill. Pulleys are 10 in. dia., using a 2 in. belt. Speed, 320 revolutions.

We claim the following as being among the many advantages gained by the use of this machine:

First.—The putting of the yarn on to quills or bobbins direct from chain, or, in other words, from chain to quill or bobbin ready for weaving without any intermediate process.

Second.—The greatly increased amount of yarn put on to quill or bobbin, the avoidance of lapped ends, and the increased product per loom gained thereby; the avoidance of burnt and burnished yarn, whereby the strength as well as the original brightness and clearness of the yarn is fully maintained.

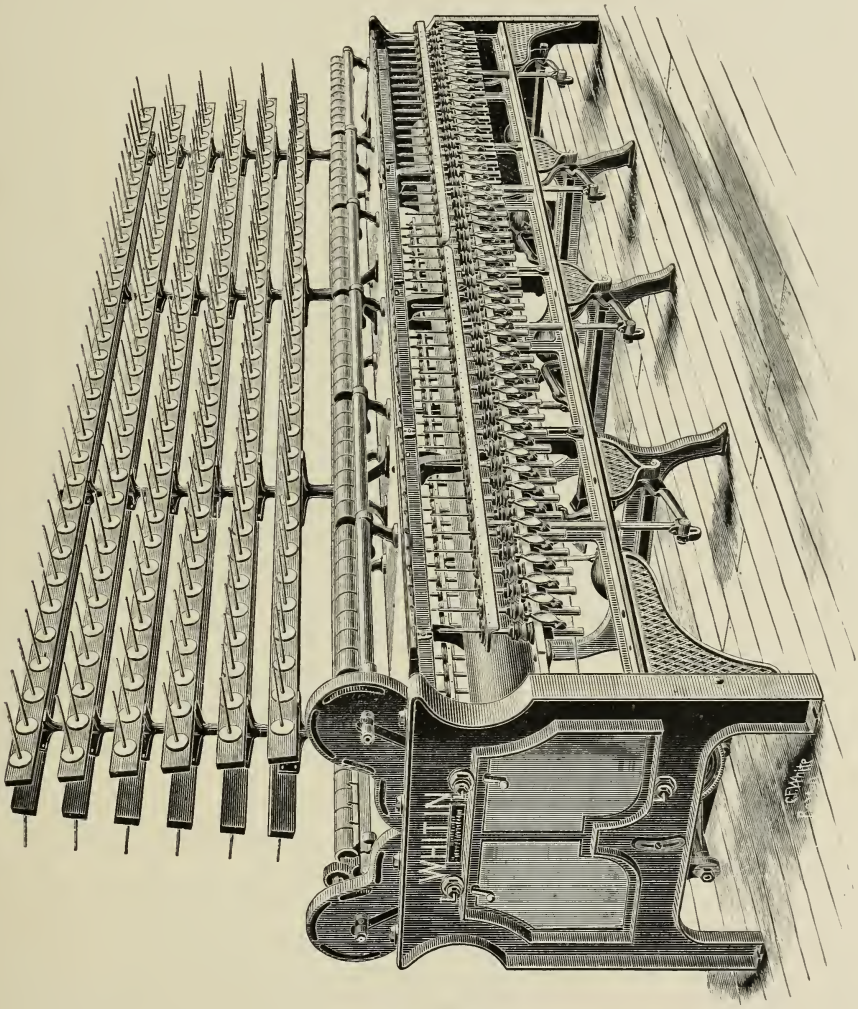
Third.—Goods look brighter and better. Second quality are largely reduced because of absence of mixed shades of color.

Fourth.—A great saving in waste is effected, and a very material reduction in cost is made.

The following table is composed of actual results reported to us from various mills using our machines. It must be borne in mind, however, that the production varies according to the efficiency of the help, and nature of the yarn whether printed or dyed, hard or soft twisted, and length of chain. We recommend using chains 9,000 yards long. It is believed, under favorable conditions, most of these figures can be excelled.

Table of Production.

No. of Spindles.	No. of Yarn.	No. of Lbs. Quilling per Day of 10 Hours.
378	$12\frac{1}{2}$	316
378	$14\frac{1}{2}$	172
378	18	150 to 200
378	25	133 to 151
378	26	125 to 150
378	28	125
378	29	98
378	$33\frac{1}{2}$	114
378	50	58



DRY TWISTER.

Dry Twister.

This Twister may be arranged to twist from either quills, spools, or beams. It is built with one line of top and two lines of bottom rolls. A simple and effective knee brake is provided with each spindle, by means of which any spindle may be stopped independently of the rest, while piecing up. The machine is thoroughly built, and is well finished throughout. The general construction is the same as in our Spinning Frames, a detailed account of which is given elsewhere. The Traverse is 4, 4½, 5, 5½, and 6 in. The Spindles are driven by a 7 in. cylinder.

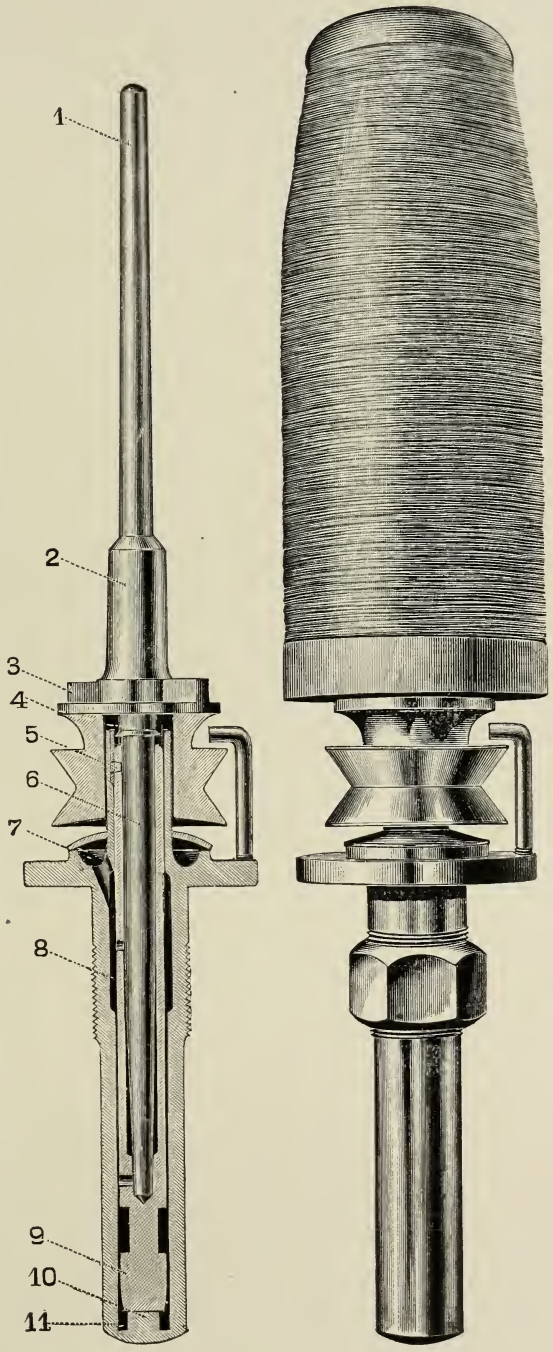
Driving Pulleys are from 6 to 14 in. diameter; width of face 2 to 3 in.

Floor Space: Width 36 in. and lengths over all as follows:

No. of Spindles.	5 in. Space.		4½ in. Space.		4 in. Space.		3½ in. Space.		3 in. Space.		2¾ in. Space.		2½ in. Space.	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
64	15	..	13	8	12	4	11	1	9	9	9	1	8	6
80	18	4	16	8	15	..	13	5	11	9	10	11	10	2
96	21	8	19	8	17	8	15	9	13	9	12	9	11	10
112	25	..	22	8	20	4	18	1	15	9	14	7	13	6
128	28	4	25	8	23	..	20	5	17	9	16	5	15	2
144	...	..	28	8	25	8	22	9	19	9	18	3	16	10
160	...	..	31	8	28	4	25	1	21	9	20	1	18	6
176	...	..	...	..	31	..	27	5	23	9	21	11	20	2
192	...	..	...	..	...	..	29	9	25	9	23	9	21	10
208	...	..	...	..	...	..	...	..	27	9	25	7	23	6
224	...	..	...	..	...	..	...	..	29	9	27	5	25	2
240	...	..	...	..	...	..	...	..	...	..	29	3	26	10
256	...	..	...	..	...	..	...	..	...	..	31	1	28	6

Gravity Twisting Spindle.

The accompanying illustration shows that the construction of our Twisting Spindles is almost identical with that of those used for spinning, the only difference being the addition of driving dogs above the whirl which fit into mortises cut in the bottom of the bobbin. This arrangement prevents the bobbin from slipping, with the attendant evil of slack twisted yàrn. The spindles are also usually built with the Doffer Guard shown in our spinning spindle. Our spindle has the great advantage in running, in that it remains perfectly true with the ring, at a low as well as a high speed. Bobbins of the style shown in the cut may be used, or they may be made with both heads the same size. They may also be made for filling wind. In our twisting frame, as now made, the spindle-rail is dropped so low that the bobbin having both heads the same size may be used, and is the style which we recommend. The spindle is made in three sizes, which we style the Wet Twister, Heavy, and the Extra Heavy Gravity Twisting Spindle. These spindles are finished in the same thorough manner as those used for spinning, are easily cleaned, and present the least possible opportunity for the collection of lint.



Dry Twister Change Twist Gear Tables.

Rolls $1\frac{3}{8}$ in. Diameter.

Cylinder 7 in. dia. Whirl $1\frac{5}{16}$ in. dia.

Ratio of Cylinder to Whirl, 1 to 4.80.

Cyl. 22 T. Stud 88 T. Roll 108 T.		Cyl. 36 T. Stud 74 T. Roll 108 T.		Cyl. 55 T. Stud 55 T. Roll 108 T.	
Stud.	Twist.	Stud.	Twist.	Stud.	Twist.
15 T	32.00	15 T	16.44	15 T	8.00
16	30.00	16	15.41	16	7.50
17	28.23	17	14.50	17	7.06
18	26.66	18	13.70	18	6.67
19	25.26	19	12.98	19	6.32
20	24.00	20	12.33	20	6.00
21	22.85	21	11.74	21	5.71
22	21.81	22	11.21	22	5.45
23	20.86	23	10.72	23	5.22
24	20.00	24	10.28	24	5.00
25	19.20	25	9.86	25	4.80
26	18.46	26	9.49	26	4.61
27	17.77	27	9.13	27	4.44
28	17.14	28	8.81	28	4.29
29	16.55	29	8.50	29	4.14
30	16.00	30	8.22	30	4.00
31	15.48	31	7.96	31	3.87
32	15.00	32	7.70	32	3.75
33	14.54	33	7.47	33	3.64
34	14.11	34	7.25	34	3.53
35	13.71	35	7.05	35	3.43
36	13.33	36	6.85	36	3.33
37	12.97	37	6.67	37	3.24
38	12.63	38	6.49	38	3.16
39	12.30	39	6.32	39	3.08
40	12.00	40	6.16	40	3.00
41	11.70	41	6.01	41	2.93
42	11.42	42	5.87	42	2.86
43	11.16	43	5.73	43	2.79
44	10.90	44	5.60	44	2.73
45	10.66	45	5.48	45	2.67
46	10.43	46	5.36	46	2.61
47	10.21	47	5.25	47	2.55
48	10.00	48	5.14	48	2.50
49	9.79	49	5.03	49	2.45
50	9.60	50	4.93	50	2.40
51	9.41	51	4.83	51	2.35
52	9.23	52	4.74	52	2.31
53	9.05	53	4.65	53	2.26
54	8.88	54	4.57	54	2.22
55	8.72	55	4.48	55	2.18
56	8.57	56	4.40	56	2.14
57	8.42	57	4.33	57	2.11
58	8.27	58	4.25	58	2.07
59	8.13	59	4.18	59	2.03
60	8.00	60	4.11	60	2.00

Heavy Gravity Twisting Spindle, weight $13\frac{1}{4}$ oz. Extra Heavy, weight 15 oz.

Dry Twister Change Twist Gear Tables.

Rolls $1\frac{3}{8}$ in. Diameter.

Cylinder 8 in. dia. Whirl $1\frac{5}{16}$ in. dia.

Ratio of Cylinder to Whirl, 1 to 5.48.

Cyl. 22 T. Stud 88 T. Roll 108 T.		Cyl. 36 T. Stud 74 T. Roll 108 T.		Cyl. 55 T. Stud 55 T. Roll 108 T.	
Stud.	Twist.	Stud.	Twist.	Stud.	Twist.
15 T	36.53	15 T	18.77	15 T	9.13
16	34.25	16	17.60	16	8.56
17	32.23	17	16.56	17	8.06
18	30.44	18	15.64	18	7.61
19	28.84	19	14.82	19	7.21
20	27.40	20	14.08	20	6.85
21	26.09	21	13.41	21	6.52
22	24.90	22	12.80	22	6.22
23	23.82	23	12.24	23	5.95
24	22.83	24	11.73	24	5.71
25	21.92	25	11.26	25	5.48
26	21.07	26	10.83	26	5.27
27	20.29	27	10.43	27	5.06
28	19.57	28	10.06	28	4.89
29	18.89	29	9.71	29	4.72
30	18.26	30	9.38	30	4.56
31	17.67	31	9.08	31	4.42
32	17.12	32	8.80	32	4.28
33	16.60	33	8.53	33	4.15
34	16.11	34	8.28	34	4.03
35	15.65	35	8.04	35	3.91
36	15.22	36	7.82	36	3.80
37	14.81	37	7.61	37	3.70
38	14.42	38	7.41	38	3.60
39	14.05	39	7.22	39	3.51
40	13.70	40	7.04	40	3.42
41	13.36	41	6.87	41	3.34
42	13.04	42	6.70	42	3.26
43	12.74	43	6.55	43	3.18
44	12.45	44	6.40	44	3.11
45	12.17	45	6.25	45	3.04
46	11.91	46	6.12	46	2.98
47	11.65	47	5.99	47	2.91
48	11.41	48	5.86	48	2.85
49	11.18	49	5.74	49	2.79
50	10.96	50	5.63	50	2.74
51	10.74	51	5.52	51	2.68
52	10.53	52	5.41	52	2.63
53	10.34	53	5.31	53	2.58
54	10.14	54	5.21	54	2.53
55	9.96	55	5.12	55	2.49
56	9.78	56	5.03	56	2.44
57	9.61	57	4.94	57	2.40
58	9.44	58	4.85	58	2.36
59	9.28	59	4.77	59	2.32
60	9.13	60	4.69	60	2.28

Heavy Gravity Twisting Spindle, weight $13\frac{1}{4}$ oz. Extra Heavy, weight 15 oz.

Production Tables of Dry Twisters. Rolls $1\frac{3}{8}$ in. Diameter.

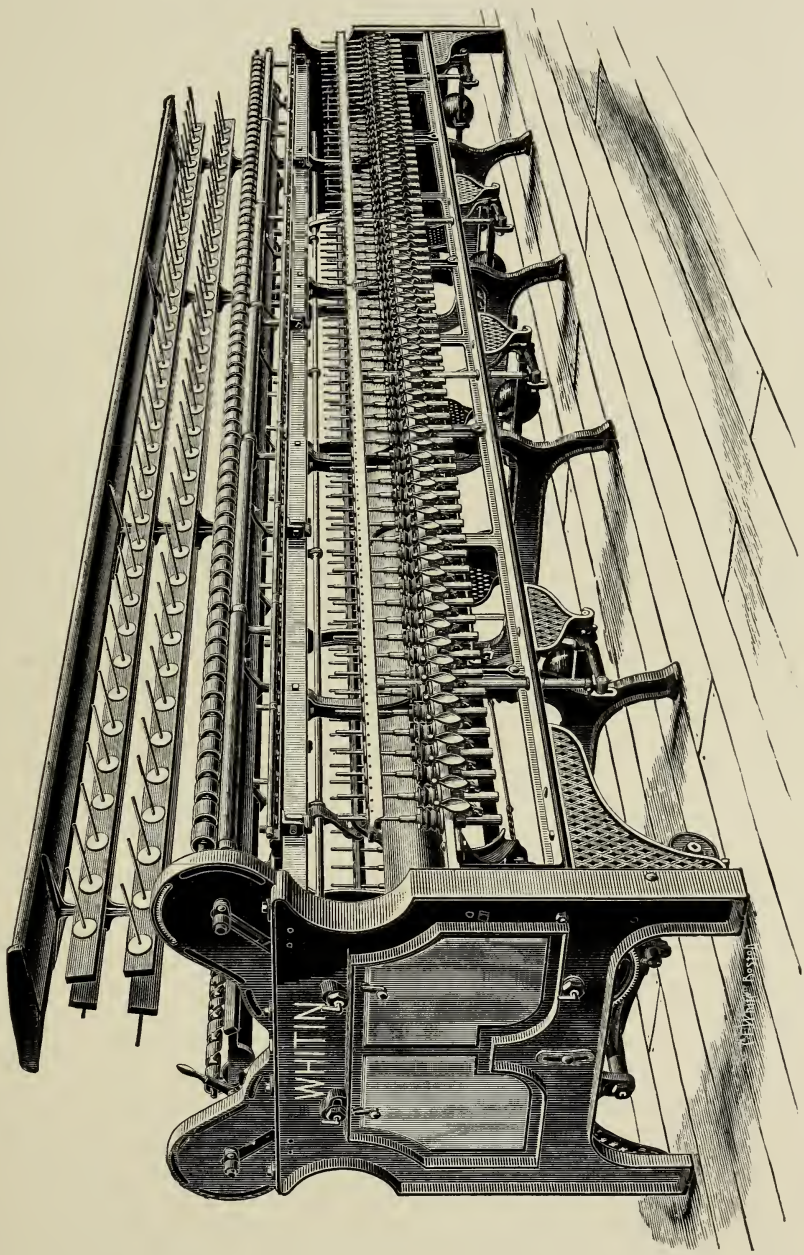
2 PLY. Multiplier 4.					3 PLY. Multiplier 4.					4 PLY. Multiplier 4.					6 PLY. Multiplier 4.				
No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.
6	4200	140	6.93	3.60	6	3400	139	5.66	5.37	6	2600	123	4.90	6.32	10	2600	116	5.16	5.36
7	4200	130	7.48	2.86	7	3400	129	6.11	4.28	7	2600	114	5.29	5.02	11	2600	111	5.42	4.68
8	4200	121	8.00	2.33	8	3400	120	6.53	3.47	8	2600	106	5.66	4.09	12	2600	106	5.66	4.09
9	4200	114	8.49	1.95	9	3400	113	6.93	2.91	9	2600	100	6.00	3.43	13	2600	102	5.89	3.63
10	4200	109	8.94	1.68	10	3400	108	7.30	2.50	10	2600	95	6.32	2.93	14	2600	98	6.11	3.25
11	4200	104	9.38	1.45	11	3400	103	7.66	2.16	11	2600	91	6.63	2.55	15	2600	95	6.32	2.93
12	4200	99	9.80	1.27	12	3400	98	8.00	1.89	12	2600	87	6.93	2.24	16	2600	92	6.53	2.66
8	5000	145	8.00	2.79	9	4200	140	6.93	3.60	13	3400	109	7.21	2.58	17	2600	89	6.73	2.42
9	5000	136	8.49	2.33	10	4200	133	7.30	3.08	14	3400	105	7.48	2.31	18	2600	87	6.93	2.24
10	5000	129	8.94	1.99	11	4200	127	7.66	2.67	15	3400	101	7.75	2.08	. . .	. . .	. . .	. . .	. . .
11	5000	123	9.38	1.72	12	4200	121	8.00	2.33	16	3400	98	8.00	1.89	. . .	. . .	. . .	. . .	. . .
12	5000	118	9.80	1.52	13	4200	117	8.33	2.08	16	4200	121	8.00	2.33	. . .	. . .	. . .	. . .	. . .
13	5000	113	10.20	1.34	14	4200	112	8.64	1.85	17	4200	118	8.25	2.14	. . .	. . .	. . .	. . .	. . .
14	5000	109	10.58	1.20	15	4200	109	8.94	1.68	18	4200	114	8.49	1.95	. . .	. . .	. . .	. . .	. . .
15	5000	106	10.95	1.09	16	4200	105	9.24	1.52	19	4200	111	8.72	1.80	. . .	. . .	. . .	. . .	. . .
16	5000	102	11.31	.98	17	4200	102	9.52	1.39	20	4200	109	8.94	1.68	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	18	4200	99	9.80	1.27	21	4200	106	9.17	1.56	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	12	5000	145	8.00	2.79	22	4200	104	9.38	1.45	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	13	5000	139	8.33	2.47	23	4200	101	9.59	1.36	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	14	5000	134	8.64	2.21	24	4200	99	9.80	1.27	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	15	5000	129	8.94	1.99	23	5000	121	9.59	1.62	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	16	5000	125	9.24	1.80	24	5000	118	9.80	1.52	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	17	5000	121	9.52	1.65	25	5000	116	10.00	1.43	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	18	5000	118	9.80	1.52	26	5000	113	10.20	1.34	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	19	5000	115	10.07	1.40	27	5000	111	10.39	1.29	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	20	5000	112	10.33	1.30	28	5000	109	10.58	1.23	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	21	5000	109	10.58	1.20	29	5000	107	10.77	1.16	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	22	5000	107	10.83	1.13	30	5000	106	10.95	1.11	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	23	5000	104	11.08	1.05	31	5000	104	11.14	1.05	. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .	24	5000	102	11.31	.98	32	5000	102	11.31	1.00	. . .	. . .	. . .	. . .	. . .

Production Tables of Dry Twisters. Rolls $1\frac{3}{8}$ in. Diameter.

2 PLY. Multiplier 5.					3 PLY. Multiplier 5.					4 PLY. Multiplier 5.					6 PLY. Multiplier 5				
No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.
8	4200	89	10.00	1.87	9	4200	103	8.66	2.88	8	3400	102	7.07	4.29	6	1800	76	5.00	6.40
9	4200	84	10.61	1.57	10	4200	97	9.13	2.45	9	3400	96	7.50	3.60	7	1800	71	5.40	5.08
10	4200	80	11.18	1.34	11	4200	93	9.57	2.17	10	3400	91	7.91	3.05	8	1800	66	5.77	4.17
11	5000	90	11.73	1.41	12	4200	89	10.00	1.91	11	3400	87	8.29	2.66	9	1800	62	6.12	3.49
12	5000	86	12.25	1.24	13	4200	85	10.41	1.69	12	3400	83	8.66	2.34	10	1800	59	6.45	3.02
13	5000	83	12.75	1.10	14	4200	82	10.80	1.52	13	3400	80	9.01	2.06	11	1800	56	6.77	2.63
14	5000	80	13.23	.98	15	4200	80	11.18	1.37	14	3400	77	9.35	1.89	12	1800	54	7.07	2.33
15	5000	77	13.69	.88	16	4200	77	11.55	1.24	15	3400	74	9.68	1.70	10	2600	85	6.45	4.30
16	5000	75	14.14	.83	17	4200	75	11.90	1.14	16	3400	72	10.00	1.55	11	2600	81	6.77	3.75
17	5500	80	14.58	.83	18	4200	73	12.25	1.04	16	4200	89	10.00	1.97	12	2600	78	7.07	3.28
18	5500	78	15.00	.76	19	5000	84	12.58	1.19	17	4200	86	10.31	1.80	13	2600	75	7.36	2.97
19	5500	76	15.41	.70	20	5000	82	12.91	1.10	18	4200	84	10.61	1.66	14	2600	72	7.64	2.62
20	5500	74	15.81	.65	21	5000	80	13.23	1.01	19	4200	82	10.90	1.52	15	2600	70	7.91	2.34
21	5500	72	16.20	.60	22	5000	78	13.54	.95	20	4200	80	11.18	1.42	16	2600	67	8.16	2.14
22	5500	70	16.58	.57	23	5000	77	13.84	.89	16	5000	106	10.00	2.28	17	2600	65	8.42	1.93
23	5500	69	16.96	.53	24	5000	75	14.14	.83	17	5000	103	10.31	2.08	18	2600	64	8.66	1.78
24	5500	67	17.32	.49	25	5500	81	14.43	.86	18	5000	100	10.61	1.91	. . .	. . .	. . .	. . .	. . .
25	5500	66	17.68	.47	26	5500	79	14.72	.81	19	5000	97	10.90	1.75	. . .	. . .	. . .	. . .	. . .
26	5500	65	18.03	.44	27	5500	78	15.00	.76	20	5000	95	11.18	1.63	. . .	. . .	. . .	. . .	. . .
27	5500	63	18.37	.42	28	5500	76	15.28	.72	21	5000	92	11.46	1.57	. . .	. . .	. . .	. . .	. . .
28	5500	62	18.71	.39	29	5500	75	15.55	.69	22	5000	90	11.73	1.46	. . .	. . .	. . .	. . .	. . .
30	6000	66	19.37	.39	30	5500	74	15.81	.65	23	5000	88	11.99	1.36	. . .	. . .	. . .	. . .	. . .
35	6000	61	20.92	.31	35	6000	74	17.08	.56	24	5000	86	12.25	1.28	. . .	. . .	. . .	. . .	. . .
40	6000	57	22.36	.25	40	6000	70	18.26	.46	25	5000	85	12.50	1.20	. . .	. . .	. . .	. . .	. . .
45	6000	54	23.72	.21	45	6000	66	19.36	.39	26	5000	83	12.75	1.14	. . .	. . .	. . .	. . .	. . .
50	6000	51	25.00	.18	50	6000	62	20.41	.33	27	5000	82	12.99	1.07	. . .	. . .	. . .	. . .	. . .
55	6000	48	26.22	.16	50	6800	71	20.41	.38	28	5000	80	13.23	1.01	. . .	. . .	. . .	. . .	. . .
60	6800	53	27.39	.16	60	6800	64	22.36	.29	29	5000	79	13.46	.97	. . .	. . .	. . .	. . .	. . .
70	6800	49	29.58	.12	70	6800	60	24.15	.23	30	5000	77	13.69	.91	. . .	. . .	. . .	. . .	. . .
80	6800	46	31.62	.10	80	6800	56	25.28	.18	32	5000	75	14.14	.83	. . .	. . .	. . .	. . .	. . .

Production Tables of Dry Twisters. Roll $1\frac{3}{8}$ in. Diameter.

2 PLY. Multiplier 6.					3 PLY. Multiplier 6.				
No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.
12	5500	86	14.70	1.13	18	5500	86	14.70	1.17
13	5500	83	15.30	1.04	19	5500	84	15.10	1.08
14	5500	80	15.87	.93	20	5500	82	15.49	1.00
15	5500	77	16.43	.83	21	5500	80	15.87	.93
16	5500	75	16.97	.76	22	5500	78	16.25	.87
17	5500	73	17.49	.70	23	5500	77	16.61	.82
18	5500	71	18.00	.64	24	5500	75	16.97	.76
19	5500	69	18.49	.59	25	5500	73	17.32	.71
20	5500	67	18.97	.54	26	5500	72	17.66	.67
21	5500	65	19.44	.50	27	5500	71	18.00	.64
22	5500	64	19.90	.47	28	5500	69	18.33	.60
23	5500	62	20.35	.44	29	5500	68	18.65	.57
24	5500	61	20.78	.41	30	5500	67	18.97	.54
25	5500	60	21.21	.39	35	5500	62	20.49	.43
26	5500	59	21.63	.37	40	5500	58	21.91	.35
27	5500	58	22.05	.35	32	6000	71	19.60	.54
28	5500	57	22.45	.33	34	6000	69	20.20	.49
29	6000	61	22.85	.34	36	6000	67	20.78	.45
30	6000	60	23.24	.32	38	6000	65	21.35	.42
35	6000	55	25.10	.26	40	6000	63	21.91	.38
40	6000	52	26.83	.21	42	6000	62	22.45	.36
45	6000	49	28.46	.18	44	6000	60	22.98	.34
50	6000	46	30.00	.15	46	6000	59	23.49	.32
40	6800	59	26.83	.24	48	6000	58	24.00	.30
45	6800	55	28.46	.20	50	6000	57	24.49	.28
50	6800	52	30.00	.17	60	6000	52	26.83	.22
55	6800	50	31.46	.15	50	6800	64	24.49	.32
60	6800	48	32.86	.13	60	6800	59	26.83	.25
70	6800	44	35.50	.10	70	6800	54	28.98	.19
80	6800	41	37.95	.08	80	6800	51	30.98	.16



WET TWISTER.

Wet Twister.

This machine is intended for water twisting. It is provided with one line top and one line bottom rolls, the rolls being of brass to prevent rusting. The yarn is held under water by a glass rod, which by a simple device can be raised, thus lifting the yarn out of water and allowing the trough to be readily cleaned. Each spindle is provided with our improved knee brake, as in our Dry Twister. The machine is arranged with a traverse of 4, 5, and 6 in. It is 36 in. wide and the spindles are driven by a 7 in. cylinder.

Floor Space required is 36 in. wide, and lengths as follows:

92	spindle	machine,	$2\frac{3}{4}$	in.	space,	12 ft.	6	in.
140	"	"	$2\frac{3}{4}$	"	"	18 "		
208	"	"	$2\frac{3}{4}$	"	"	25 "	6	"
256	"	"	$2\frac{3}{4}$	"	"	31 "		
82	"	"	3	"	"	12 "	2	"
124	"	"	3	"	"	17 "	5	"
166	"	"	3	"	"	22 "	8	"
208	"	"	3	"	"	27 "	11	"
70	"	"	$3\frac{1}{2}$	"	"	12 "	2	"
106	"	"	$3\frac{1}{2}$	"	"	17 "	5	"
142	"	"	$3\frac{1}{2}$	"	"	22 "	8	"
178	"	"	$3\frac{1}{2}$	"	"	27 "	11	"
62	"	"	4	"	"	12 "		
94	"	"	4	"	"	17 "	4	"
126	"	"	4	"	"	22 "	8	"
158	"	"	4	"	"	28 "		
50	"	"	5	"	"	12 "	2	"
74	"	"	5	"	"	17 "	7	"
98	"	"	5	"	"	23 "		
122	"	"	5	"	"	28 "	5	"

The lengths given are outside of pulleys.

Driving Pulleys are 12 in. dia. and 2 in. face.

Wet Twister Change Twist Gear Tables.

Front Roll $1\frac{1}{2}$ in. Diameter.

Cylinder 7 in. dia.	Whirl $\frac{7}{8}$ in. dia.	Cylinder 8 in. dia.	Whirl $\frac{7}{8}$ in. dia.
Ratio, Cyl. to Whirl : : 1 : 7.25.		Ratio, Cyl. to Whirl : : 1 : 8.28.	
Cyl. 22 T. Stud 88 T.	Cyl. 36 T. Stud 74 T.	Cyl. 22 T. Stud 88 T.	Cyl. 36 T. Stud 74 T.
Front Roll 112 T.	Front Roll 112 T.	Front Roll 112 T.	Front Roll 112 T.

On Stud.	Twist.	On Stud	Twist.	On Stud.	Twist.	On Stud.	Twist.
15	45.93	15	23.60	15	52.46	15	26.96
16	43.06	16	22.14	16	49.18	16	25.27
17	40.53	17	20.83	17	46.28	17	23.78
18	38.28	18	19.67	18	43.71	18	22.46
19	36.26	19	18.63	19	41.41	19	21.28
20	34.44	20	17.70	20	39.34	20	20.21
21	32.81	21	16.86	21	37.47	21	19.25
22	31.32	22	16.08	22	35.77	22	18.38
23	29.96	23	15.35	23	34.21	23	17.58
24	28.71	24	14.75	24	32.78	24	16.85
25	27.56	25	14.16	25	31.47	25	16.17
26	26.50	26	13.62	26	30.26	26	15.55
27	25.52	27	13.11	27	29.14	27	14.98
28	24.61	28	12.66	28	28.10	28	14.44
29	23.75	29	12.21	29	27.13	29	13.94
30	22.96	30	11.80	30	26.23	30	13.47
31	22.22	31	11.42	31	25.38	31	13.04
32	21.53	32	11.06	32	24.59	32	12.64
33	20.88	33	10.73	33	23.84	33	12.25
34	20.26	34	10.41	34	23.14	34	11.89
35	19.68	35	10.11	35	22.48	35	11.55
36	19.13	36	9.84	36	21.86	36	11.23
37	18.62	37	9.57	37	21.26	37	10.93
38	18.13	38	9.32	38	20.71	38	10.64
39	17.69	39	9.08	39	20.17	39	10.36
40	17.22	40	8.85	40	19.67	40	10.11
41	16.80	41	8.63	41	19.19	41	9.86
42	16.40	42	8.43	42	18.73	42	9.63
43	16.02	43	8.23	43	18.34	43	9.40
44	15.66	44	8.04	44	17.88	44	9.19
45	15.33	45	7.86	45	17.48	45	8.98
46	14.98	46	7.69	46	17.11	46	8.79
47	14.66	47	7.53	47	16.74	47	8.60
48	14.35	48	7.37	48	16.39	48	8.42
49	14.06	49	7.22	49	16.06	49	8.25
50	13.78	50	7.08	50	15.73	50	8.09
52	13.25	52	6.81	52	15.13	52	7.77
54	12.76	54	6.55	54	14.57	54	7.49
56	12.30	56	6.32	56	14.05	56	7.22
58	11.88	58	6.10	58	13.56	58	6.97
60	11.48	60	5.90	60	13.11	60	6.74

Wet Twister Change Twist Gear Tables.

Front Roll $1\frac{1}{2}$ in. Diameter.

Cylinder 7 in. dia. Whirl $1\frac{5}{16}$ in. dia.				Cylinder 8 in. dia. Whirl $1\frac{5}{16}$ in. dia.			
Ratio, Cyl. to Whirl : : 1 : 4.80.				Ratio, Cyl. to Whirl : : 1 : 5.48.			
Cyl. 22 T. Stud 88 T.		Cyl. 36 T. Stud 74 T.		Cyl. 22 T. Stud 88 T.		Cyl. 36 T. Stud 74 T.	
Front Roll 112 T.		Front Roll 112 T.		Front Roll 112 T.		Front Roll 112 T.	
On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.	On Stud.	Twist.
15	30.41	15	15.63	15	34.72	15	17.84
16	28.51	16	14.65	16	32.55	16	16.73
17	26.83	17	13.79	17	30.63	17	15.74
18	25.34	18	13.02	18	28.93	18	14.86
19	24.01	19	12.34	19	27.41	19	14.08
20	22.80	20	11.72	20	26.04	20	13.38
21	21.72	21	11.16	21	24.79	21	12.74
22	20.73	22	10.66	22	23.67	22	12.16
23	19.83	23	10.19	23	22.64	23	11.64
24	19.01	24	9.77	24	21.69	24	11.15
25	18.24	25	9.38	25	20.83	25	10.71
26	17.54	26	9.02	26	20.03	26	10.29
27	16.89	27	8.68	27	19.29	27	9.91
28	16.29	28	8.37	28	18.60	28	9.56
29	15.73	29	8.08	29	17.95	29	9.21
30	15.20	30	7.81	30	17.35	30	8.92
31	14.71	31	7.56	31	16.80	31	8.63
32	14.27	32	7.33	32	16.28	32	8.36
33	13.82	33	7.10	33	15.78	33	8.11
34	13.41	34	6.89	34	15.31	34	7.86
35	13.03	35	6.70	35	14.88	35	7.65
36	12.67	36	6.51	36	14.46	36	7.43
37	12.33	37	6.33	37	14.07	37	7.23
38	12.00	38	6.17	38	13.70	38	7.04
39	11.68	39	6.01	39	13.35	39	6.86
40	11.40	40	5.86	40	13.02	40	6.69
41	11.13	41	5.72	41	12.70	41	6.53
42	10.87	42	5.58	42	12.40	42	6.37
43	10.61	43	5.45	43	12.11	43	6.22
44	10.34	44	5.33	44	11.83	44	6.08
45	10.13	45	5.21	45	11.57	45	5.95
46	9.92	46	5.09	46	11.32	46	5.82
47	9.71	47	4.99	47	11.08	47	5.69
48	9.50	48	4.88	48	10.85	48	5.57
49	9.31	49	4.78	49	10.63	49	5.46
50	9.12	50	4.69	50	10.41	50	5.35
52	8.77	52	4.51	52	10.01	52	5.15
54	8.45	54	4.34	54	9.65	54	4.96
56	8.14	56	4.19	56	9.30	56	4.78
58	7.86	58	4.04	58	8.98	58	4.62
60	7.60	60	3.91	60	8.66	60	4.46

Production Tables of Wet Twisters. Rolls 1½ in. Diameter.

2 PLY. Multiplier 5.					3 PLY. Multiplier 5.					4 PLY. Multiplier 5.					6 PLY. Multiplier 5.				
No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.	No. Yarn to be Twisted.	Rev. of Spindle per Min.	Rev. of Roll per Min.	Twist per Inch.	Lbs. per day per Spindle.
8	4200	97	10.00	1.87	9	4200	112	8.66	2.88	8	3400	111	7.07	4.29	6	1800	83	5.00	6.40
9	4200	92	10·61	1.57	10	4200	106	9.13	2.45	9	3400	105	7.50	3.60	7	1800	77	5.40	5.08
10	4200	87	11.18	1.34	11	4200	101	9.57	2.17	10	3400	99	7.91	3.05	8	1800	72	5.77	4.17
11	5000	99	11.73	1.41	12	4200	97	10.00	1.91	11	3400	95	8.29	2.66	9	1800	68	6.12	3.49
12	5000	94	12.25	1.24	13	4200	93	10.41	1.69	12	3400	91	8.66	2.34	10	1800	63	6.45	3.02
13	5000	91	12.75	1.10	14	4200	90	10.80	1.52	13	3400	87	9.01	2.06	11	1800	61	6.77	2.63
14	5000	87	13.23	.98	15	4200	87	11.18	1.37	14	3400	84	9.35	1.89	12	1800	59	7.07	2.33
15	5000	84	13.69	.88	16	4200	84	11.55	1.24	15	3400	81	9.68	1.70	10	2600	93	6.45	4.30
16	5000	82	14.14	.83	17	4200	82	11.90	1.14	16	3400	79	10.00	1.55	11	2600	89	6.77	3.75
17	5500	87	14.58	.83	18	4200	79	12.25	1.04	16	4200	97	10.00	1.97	12	2600	85	7.07	3.28
18	5500	85	15.00	.76	19	5000	92	12.58	1.19	17	4200	94	10.31	1.80	13	2600	82	7.36	2.97
19	5500	82	15.41	.70	20	5000	90	12.91	1.10	18	4200	92	10.61	1.66	14	2600	79	7.64	2.62
20	5500	80	15.81	.65	21	5000	87	13.23	1.01	19	4200	89	10.90	1.52	15	2600	76	7.91	2.34
21	5500	78	16.20	.60	22	5000	85	13.54	.95	20	4200	87	11.18	1.42	16	2600	74	8.16	2.14
22	5500	77	16.58	.57	23	5000	84	13.84	.89	16	5000	116	10.00	2.28	17	2600	71	8.42	1.93
23	5500	75	16.96	.53	24	5000	82	14.14	.83	17	5000	112	10.31	2.08	18	2600	69	8.66	1.78
24	5500	73	17.32	.49	25	5500	88	14.43	.86	18	5000	109	10.61	1.91	. . .	. . .	. . .	. . .	. . .
25	5500	72	17.68	.47	26	5500	86	14.72	.81	19	5000	106	10.90	1.75	. . .	. . .	. . .	. . .	. . .
26	5500	70	18.03	.44	27	5500	85	15.00	.76	20	5000	103	11.18	1.63	. . .	. . .	. . .	. . .	. . .
27	5500	69	18.37	.42	28	5500	83	15.28	.72	21	5000	101	11.46	1.57	. . .	. . .	. . .	. . .	. . .
28	5500	68	18.71	.39	29	5500	82	15.55	.69	22	5000	99	11.73	1.46	. . .	. . .	. . .	. . .	. . .
30	6000	72	19.37	.39	30	5500	80	15.81	.65	23	5000	96	11.99	1.36	. . .	. . .	. . .	. . .	. . .
35	6000	66	20.92	.31	35	6000	81	17.08	.56	24	5000	94	12.25	1.28	. . .	. . .	. . .	. . .	. . .
40	6000	62	22.36	.25	40	6000	76	18.26	.46	25	5000	92	12.50	1.20	. . .	. . .	. . .	. . .	. . .
45	6000	58	23.72	.21	45	6000	72	19.36	.39	26	5000	91	12.75	1.14	. . .	. . .	. . .	. . .	. . .
50	6000	55	25.00	.18	50	6000	68	20.41	.33	27	5000	89	12.99	1.07	. . .	. . .	. . .	. . .	. . .
55	6000	53	26.22	.16	50	6800	77	20.41	.38	28	5000	87	13.23	1.01	. . .	. . .	. . .	. . .	. . .
60	6800	57	27.39	.16	60	6800	70	22.36	.29	29	5000	86	13.46	.97	. . .	. . .	. . .	. . .	. . .
70	6800	53	29.58	.12	70	6800	65	24.15	.23	30	5000	84	13.69	.91	. . .	. . .	. . .	. . .	. . .
80	6800	50	31.62	.10	80	6800	61	25.82	.18	32	5000	82	14.14	.83	. . .	. . .	. . .	. . .	. . .

Twist Tables for Twisting Yarns.

Two Ply.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by		
			4	5	6				4	5	6
1	.5	.7071	2.83	3.54	4.24	51	25.5	5.0498	20.20	25.25	30.30
2	1.	1.	4.	5.	6.	52	26.	5.0990	20.40	25.50	30.59
3	1.5	1.2247	4.90	6.12	7.35	53	26.5	5.1478	20.59	25.74	30.89
4	2.	1.4142	5.66	7.07	8.49	54	27.	5.1962	20.78	25.98	31.18
5	2.5	1.5811	6.32	7.91	9.49	55	27.5	5.2440	20.98	26.22	31.46
6	3.	1.7321	6.93	8.66	10.39	56	28.	5.2915	21.17	26.46	31.75
7	3.5	1.8708	7.48	9.35	11.22	57	28.5	5.3385	21.35	26.69	32.03
8	4.	2.	8.	10.	12.	58	29.	5.3852	21.54	26.93	32.31
9	4.5	2.1213	8.49	10.61	12.73	59	29.5	5.4314	21.73	27.16	32.59
10	5.	2.2361	8.94	11.18	13.42	60	30.	5.4772	21.91	27.39	32.86
11	5.5	2.3452	9.38	11.73	14.07	61	30.5	5.5227	22.09	27.61	33.14
12	6.	2.4495	9.80	12.25	14.70	62	31.	5.5678	22.27	27.84	33.41
13	6.5	2.5495	10.20	12.75	15.30	63	31.5	5.6125	22.45	28.06	33.67
14	7.	2.6458	10.58	13.23	15.87	64	32.	5.6569	22.63	28.28	33.94
15	7.5	2.7386	10.95	13.69	16.43	65	32.5	5.7009	22.80	28.50	34.21
16	8.	2.8284	11.31	14.14	16.97	66	33.	5.7446	22.98	28.72	34.47
17	8.5	2.9155	11.66	14.58	17.49	67	33.5	5.7879	23.15	28.94	34.73
18	9.	3.	12.	15.	18.	68	34.	5.8310	23.32	29.15	34.99
19	9.5	3.0822	12.33	15.41	18.49	69	34.5	5.8737	23.49	29.37	35.24
20	10.	3.1623	12.65	15.81	18.97	70	35.	5.9161	23.66	29.58	35.50
21	10.5	3.2404	12.96	16.20	19.44	71	35.5	5.9582	23.83	29.79	35.75
22	11.	3.3166	13.27	16.58	19.90	72	36.	6.	24.	30.	36.
23	11.5	3.3912	13.56	16.96	20.35	73	36.5	6.0415	24.17	30.21	36.25
24	12.	3.4641	13.86	17.32	20.78	74	37.	6.0828	24.33	30.41	36.50
25	12.5	3.5355	14.14	17.68	21.21	75	37.5	6.1237	24.49	30.62	36.74
26	13.	3.6056	14.42	18.03	21.63	76	38.	6.1644		30.82	36.99
27	13.5	3.6742	14.70	18.37	22.05	77	38.5	6.2049		31.02	37.23
28	14.	3.7417	14.97	18.71	22.45	78	39.	6.2450		31.22	37.47
29	14.5	3.8079	15.23	19.04	22.85	79	39.5	6.2849		31.42	37.71
30	15.	3.8730	15.49	19.37	23.24	80	40.	6.3246		31.62	37.95
31	15.5	3.9370	15.75	19.69	23.62	81	40.5	6.3640		31.82	38.18
32	16.	4.	16.	20.	24.	82	41.	6.4031		32.02	38.42
33	16.5	4.0620	16.25	20.31	24.37	83	41.5	6.4420		32.21	38.65
34	17.	4.1231	16.49	20.62	24.74	84	42.	6.4807		32.40	38.88
35	17.5	4.1833	16.73	20.92	25.10	85	42.5	6.5192		32.60	39.12
36	18.	4.2426	16.97	21.21	25.46	86	43.	6.5574		32.79	39.34
37	18.5	4.3012	17.20	21.51	25.81	87	43.5	6.5955		32.98	39.57
38	19.	4.3589	17.44	21.79	26.15	88	44.	6.6332		33.17	39.80
39	19.5	4.4159	17.66	22.08	26.50	89	44.5	6.6708		33.35	40.02
40	20.	4.4721	17.89	22.36	26.83	90	45.	6.7082		33.54	40.25
41	20.5	4.5277	18.11	22.64	27.17	91	45.5	6.7454		33.73	40.47
42	21.	4.5826	18.33	22.91	27.50	92	46.	6.7823		33.91	40.69
43	21.5	4.6368	18.55	23.18	27.82	93	46.5	6.8191		34.10	40.91
44	22.	4.6904	18.76	23.45	28.14	94	47.	6.8557		34.28	41.13
45	22.5	4.7434	18.97	23.72	28.46	95	47.5	6.8920		34.46	41.35
46	23.	4.7958	19.18	23.98	28.77	96	48.	6.9282		34.64	41.57
47	23.5	4.8477	19.39	24.24	29.09	97	48.5	6.9642		34.82	41.78
48	24.	4.8990	19.60	24.49	29.39	98	49.	7.		35.	42.
49	24.5	4.9497	19.80	24.75	29.70	99	49.5	7.0356		35.18	42.21
50	25.	5.	20.	25.	30.	100	50.	7.0711		35.36	42.43

Twist Tables for Twisting Yarns.

Three Ply.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by		
			4	5	6				4	5	6
1	.33	.5774	2.31	2.89	3.46	51	17.	4.1231	16.49	20.62	24.74
2	.67	.8165	3.27	4.08	4.90	52	17.33	4.1633	16.65	20.82	24.98
3	1.	1.	4.	5.	6.	53	17.67	4.2032	16.81	21.02	25.22
4	1.33	1 1547	4.62	5.77	6.93	54	18.	4.2426	16.97	21.21	25.46
5	1.67	1.2910	5.16	6.45	7.75	55	18.33	4.2817	17.13	21.41	25.69
6	2.	1.4142	5.66	7.07	8.49	56	18.67	4.3205	17.28	21.60	25.92
7	2.33	1.5275	6.11	7.64	9.17	57	19.	4.3589	17.44	21.79	26.15
8	2.67	1.6330	6.53	8.16	9.80	58	19.33	4.3970	17.59	21.98	26.38
9	3.	1.7321	6.93	8.66	10.39	59	19.67	4.4347	17.74	22.17	26.61
10	3.33	1.8257	7.30	9.13	10.95	60	20.	4.4721	17.89	22.36	26.83
11	3.67	1.9149	7.66	9.57	11.49	61	20.33	4.5092	18.04	22.55	27.06
12	4.	2.	8.	10.	12.	62	20.67	4.5461	18.18	22.73	27.28
13	4.33	2.0817	8.33	10.41	12.49	63	21.	4.5826	18.33	22.91	27.50
14	4.67	2.1602	8.64	10.80	12.96	64	21.33	4.6188	18.48	23.09	27.71
15	5.	2.2361	8.94	11.18	13.42	65	21.67	4.6547	18.62	23.27	27.93
16	5.33	2.3094	9.24	11.55	13.86	66	22.	4.6904	18.76	23.45	28.14
17	5.67	2.3805	9.52	11.90	14.28	67	22.33	4.7258	18.90	23.63	28.35
18	6.	2.4495	9.80	12.25	14.70	68	22.67	4.7610	19.04	23.80	28.57
19	6.33	2.5166	10.07	12.58	15.10	69	23.	4.7958	19.18	23.98	28.77
20	6.67	2.5820	10.33	12.91	15.49	70	23.33	4.8305	19.32	24.15	28.98
21	7.	2.6458	10.58	13.23	15.87	71	23.67	4.8648	19.46	24.32	29.19
22	7.33	2.7080	10.83	13.54	16.25	72	24.	4.8990	19.60	24.49	29.39
23	7.67	2.7689	11.08	13.84	16.61	73	24.33	4.9329	19.73	24.66	29.60
24	8.	2.8284	11.31	14.14	16.97	74	24.67	4.9666	19.87	24.83	29.80
25	8.33	2.8868	11.55	14.43	17.32	75	25.	5.	20.	25.	30.
26	8.67	2.9439	11.76	14.72	17.66	76	25.33	5.0332		25.17	30.20
27	9.	3.	12.	15.	18.	77	25.67	5.0662		25.33	30.40
28	9.33	3.0551	12.22	15.28	18.33	78	26.	5.0990		25.50	30.59
29	9.67	3.1091	12.44	15.55	18.65	79	26.33	5.1316		25.66	30.79
30	10.	3.1623	12.65	15.81	18.97	80	26.67	5.1640		25.82	30.98
31	10.33	3.2145	12.86	16.07	19.29	81	27.	5.1962		25.98	31.18
32	10.67	3.2659	13.06	16.33	19.60	82	27.33	5.2281		26.14	31.37
33	11.	3.3166	13.27	16.58	19.90	83	27.67	5.2599		26.30	31.56
34	11.33	3.3665	13.47	16.83	20.20	84	28.	5.2915		26.46	31.75
35	11.67	3.4157	13.66	17.08	20.49	85	28.33	5.3229		26.61	31.94
36	12.	3.4641	13.86	17.32	20.78	86	28.67	5.3541		26.77	32.12
37	12.33	3.5119	14.05	17.56	21.07	87	29.	5.3852		26.93	32.31
38	12.67	3.5590	14.24	17.80	21.35	88	29.33	5.4160		27.08	32.50
39	13.	3.6056	14.42	18.03	21 63	89	29.67	5.4467		27.23	32.68
40	13.33	3.6515	14.61	18.26	21.91	90	30.	5.4772		27.39	32.86
41	13.67	3.6969	14.79	18.48	22.18	91	30.33	5.5076		27.54	33.05
42	14.	3.7417	14.97	18.71	22.45	92	30.67	5.5377		27.69	33 23
43	14.33	3.7859	15.14	18.93	22.72	93	31.	5.5678		27.84	33.41
44	14.67	3.8297	15.32	19.15	22.98	94	31.33	5.5976		27.99	33.59
45	15.	3.8730	15.49	19.36	23.24	95	31.67	5.6273		28.14	33.76
46	15.33	3.9158	15.66	19.58	23.49	96	32.	5.6569		28.28	33.94
47	15.67	3.9582	15.83	19.79	23.75	97	32.33	5.6862		28.43	34.12
48	16.	4.	16.	20.	24.	98	32.67	5.7155		28.58	34.29
49	16.33	4.0415	16.17	20.21	24.25	99	33.	5.7446		28.72	34.47
50	16.67	4.0825	16.33	20.41	24.49	100	33.33	5.7735		28.87	34.64

Twist Tables for Twisting Yarns.

Four Ply.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by		
			4	5	6				4	5	6
1	.25	.5	2.	2.5	3.	51	12.75	3.5707	14.28	17.85	21.42
2	.50	.7071	2.83	3.54	4.24	52	13.	3.6056	14.42	18.03	21.63
3	.75	.8660	3.46	4.33	5.20	53	13.25	3.6401	14.56	18.20	21.84
4	1.	1.	4.	5.	6.	54	13.50	3.6742	14.70	18.37	22.05
5	1.25	1.1180	4.47	5.59	6.71	55	13.75	3.7081	14.83	18.54	22.25
6	1.50	1.2247	4.90	6.12	7.35	56	14.	3.7417	14.97	18.71	22.45
7	1.75	1.3229	5.29	6.61	7.94	57	14.25	3.7749	15.10	18.87	22.65
8	2.	1.4142	5.66	7.07	8.49	58	14.50	3.8079	15.23	19.04	22.85
9	2.25	1.5	6.	7.5	9.	59	14.75	3.8406	15.36	19.20	23.04
10	2.50	1.5811	6.32	7.91	9.49	60	15.	3.8730	15.49	19.37	23.24
11	2.75	1.6583	6.63	8.29	9.95	61	15.25	3.9051	15.62	19.53	23.43
12	3.	1.7321	6.93	8.66	10.39	62	15.50	3.9370	15.75	19.69	23.62
13	3.25	1.8028	7.21	9.01	10.82	63	15.75	3.9686	15.88	19.84	23.81
14	3.50	1.8708	7.48	9.35	11.22	64	16.	4.	16.	20.	24.
15	3.75	1.9365	7.75	9.68	11.62	65	16.25	4.0311	16.12	20.16	24.19
16	4.	2.	8.	10.	12.	66	16.50	4.0620	16.25	20.31	24.37
17	4.25	2.0616	8.25	10.31	12.37	67	16.75	4.0927	16.37	20.46	24.56
18	4.50	2.1213	8.49	10.61	12.73	68	17.	4.1231	16.49	20.62	24.74
19	4.75	2.1794	8.72	10.90	13.08	69	17.25	4.1533	16.61	20.77	24.92
20	5.	2.2361	8.94	11.18	13.42	70	17.50	4.1833	16.73	20.92	25.10
21	5.25	2.2913	9.17	11.46	13.75	71	17.75	4.2130	16.85	21.07	25.28
22	5.50	2.3452	9.38	11.73	14.07	72	18.	4.2426	16.97	21.21	25.46
23	5.75	2.3979	9.59	11.99	14.39	73	18.25	4.2720	17.09	21.36	25.63
24	6.	2.4495	9.80	12.25	14.70	74	18.50	4.3012	17.20	21.51	25.81
25	6.25	2.5	10.	12.5	15.	75	18.75	4.3301	17.32	21.65	25.98
26	6.50	2.5495	10.20	12.75	15.30	76	19.	4.3589		21.79	26.15
27	6.75	2.5981	10.39	12.99	15.59	77	19.25	4.3875		21.94	26.32
28	7.	2.6458	10.58	13.23	15.87	78	19.50	4.4159		22.08	26.50
29	7.25	2.6926	10.77	13.46	16.16	79	19.75	4.4441		22.22	26.66
30	7.50	2.7386	10.95	13.69	16.43	80	20.	4.4721		22.36	26.83
31	7.75	2.7839	11.14	13.92	16.70	81	20.25	4.5		22.5	27.
32	8.	2.8284	11.31	14.14	16.97	82	20.50	4.5277		22.64	27.17
33	8.25	2.8723	11.49	14.36	17.23	83	20.75	4.5552		22.78	27.33
34	8.50	2.9155	11.66	14.58	17.49	84	21.	4.5826		22.91	27.50
35	8.75	2.9580	11.83	14.79	17.75	85	21.25	4.6098		23.05	27.66
36	9.	3.	12.	15.	18.	86	21.50	4.6368		23.18	27.82
37	9.25	3.0414	12.17	15.21	18.25	87	21.75	4.6637		23.32	27.98
38	9.50	3.0822	12.33	15.41	18.49	88	22.	4.6904		23.45	28.14
39	9.75	3.1225	12.49	15.61	18.73	89	22.25	4.7170		23.58	28.30
40	10.	3.1623	12.65	15.81	18.97	90	22.50	4.7434		23.72	28.46
41	10.25	3.2016	12.81	16.01	19.21	91	22.75	4.7697		23.85	28.62
42	10.50	3.2404	12.96	16.20	19.44	92	23.	4.7958		23.98	28.77
43	10.75	3.2787	13.11	16.39	19.67	93	23.25	4.8218		24.11	28.93
44	11.	3.3166	13.27	16.58	19.90	94	23.50	4.8477		24.24	29.09
45	11.25	3.3541	13.42	16.77	20.12	95	23.75	4.8734		24.37	29.24
46	11.50	3.3912	13.56	16.96	20.35	96	24.	4.8990		24.49	29.39
47	11.75	3.4278	13.71	17.14	20.57	97	24.25	4.9244		24.62	29.55
48	12.	3.4641	13.86	17.32	20.78	98	24.50	4.9497		24.75	29.70
49	12.25	3.5	14.	17.5	21.	99	24.75	4.9749		24.87	29.85
50	12.50	3.5355	14.14	17.68	21.21	100	25.	5.		25.	30.

Twist Tables for Twisting Yarns.

Five Ply.

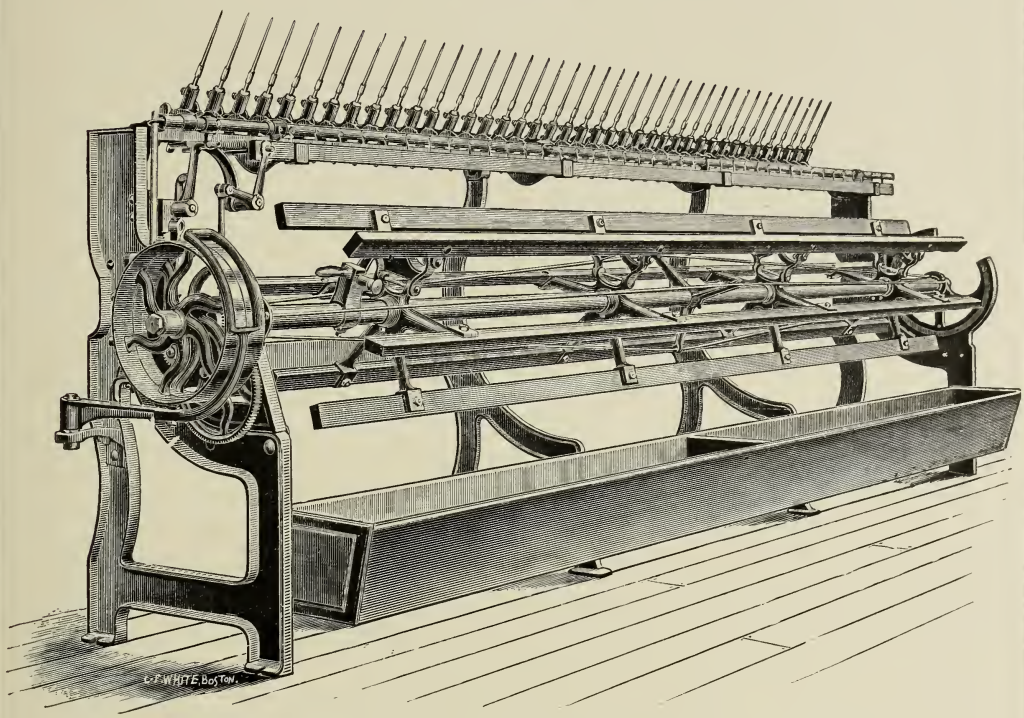
No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by		
			4	5	6				4	5	6
1	.2	.4472	1.79	2.24	2.68	51	10.2	3.1937	12.77	15.97	19.16
2	.4	.6325	2.53	3.16	3.79	52	10.4	3.2249	12.90	16.12	19.35
3	.6	.7746	3.10	3.87	4.65	53	10.6	3.2558	13.02	16.28	19.53
4	.8	.8944	3.58	4.47	5.37	54	10.8	3.2863	13.15	16.43	19.72
5	1.	1.	4.	5.	6.	55	11.	3.3166	13.27	16.58	19.90
6	1.2	1.0954	4.38	5.48	6.57	56	11.2	3.3466	13.39	16.73	20.08
7	1.4	1.1832	4.73	5.92	7.10	57	11.4	3.3764	13.51	16.88	20.26
8	1.6	1.2649	5.06	6.32	7.59	58	11.6	3.4059	13.62	17.03	20.44
9	1.8	1.3416	5.37	6.71	8.05	59	11.8	3.4351	13.74	17.18	20.61
10	2.	1.4142	5.66	7.07	8.49	60	12.	3.4641	13.86	17.32	20.78
11	2.2	1.4832	5.93	7.42	8.90	61	12.2	3.4928	13.97	17.46	20.96
12	2.4	1.5492	6.20	7.75	9.30	62	12.4	3.5214	14.09	17.61	21.13
13	2.6	1.6125	6.45	8.06	9.67	63	12.6	3.5496	24.20	17.75	21.30
14	2.8	1.6733	6.69	8.37	10.04	64	12.8	3.5777	14.31	17.89	21.47
15	3.	1.7321	6.93	8.66	10.39	65	13.	3.6056	14.42	18.03	21.63
16	3.2	1.7889	7.16	8.95	10.73	66	13.2	3.6332	14.53	18.17	21.80
17	3.4	1.8439	7.38	9.22	11.06	67	13.4	3.6606	14.64	18.30	21.96
18	3.6	1.8974	7.59	9.49	11.38	68	13.6	3.6878	14.75	18.44	22.13
19	3.8	1.9494	7.80	9.75	11.70	69	13.8	3.7148	14.86	18.56	22.29
20	4.	2.	8.	10.	12.	70	14.	3.7417	14.97	18.71	22.45
21	4.2	2.0494	8.20	10.25	12.30	71	14.2	3.6783	15.07	18.84	22 61
22	4.4	2.0976	8.39	10.49	12.59	72	14.4	3.7948	15.18	18.97	22.77
23	4.6	2.1448	8.58	10.72	12.87	73	14.6	3.8210	15.28	19.10	22.93
24	4.8	2.1909	8.76	10.95	13.15	74	14.8	3.8471	15.38	19.24	23.08
25	5.	2.2361	8.94	11.18	13.42	75	15.	3.8730	15.49	19.37	23.24
26	5.2	2.2804	9.12	11.40	13.68	76	15.2	3.8987		19.49	23.39
27	5.4	2.3238	9.30	11.62	13.94	77	15.4	3.9243		19.62	23.55
28	5.6	2.3664	9.47	11.83	14.20	78	15.6	3.9497		19.75	23.70
29	5.8	2.4083	9.63	12.04	14.45	79	15.8	3.9749		19.87	23.85
30	6.	2.4495	9.80	12.25	14.70	80	16.	4.		20.	24.
31	6.2	2.4900	9.96	12.45	14.94	81	16.2	4.0249		20.12	24.15
32	6.4	2.5298	10.12	12.65	15.18	82	16.4	4.0497		20.25	24.30
33	6.6	2.5690	10.28	12.85	15.41	83	16.6	4.0743		20.37	24.45
34	6.8	2.6077	10.43	13.04	15.65	84	16.8	4.0988		20.49	24.59
35	7.	2.6458	10.58	13.23	15.87	85	17.	4.1231		20.62	24.74
36	7.2	2.6833	10.73	13.42	16.10	86	17.2	4.1473		20.74	24.88
37	7.4	2.7203	10.88	13.60	16.32	87	17.4	4.1713		20.86	25.03
38	7.6	2.7568	11.03	13.78	16.54	88	17.6	4.1952		20.98	25.17
39	7.8	2.7928	11.17	13.96	16.76	89	17.8	4.2190		21.10	25.31
40	8.	2.8284	11.31	14.14	16.97	90	18.	4.2426		21.21	25.46
41	8.2	2.8636	11.45	14.32	17.18	91	18.2	4.2661		21.33	25.60
42	8.4	2.8983	11.59	14.49	17.39	92	18.4	4.2895		21.45	25.74
43	8.6	2.9326	11.73	14.66	17.60	93	18.6	4.3128		21.56	25.88
44	8.8	2.9665	11.87	14.83	17.80	94	18.8	4.3359		21.68	26.02
45	9.	3.	12.	15	18.	95	19.	4.3589		21.79	26.15
46	9.2	3.0332	12.13	15.17	18.20	96	19.2	4.3818		21.91	26.29
47	9.4	3.0659	12.26	15.33	18.40	97	19.4	4.4045		22.02	26.43
48	9.6	3.0984	12.39	15.49	18.59	98	19.6	4.4272		22.14	26.50
49	9.8	3.1305	12.52	15.65	18.78	99	19.8	4.4497		22.25	26.70
50	10.	3.1623	12.65	15.81	18.97	100	20.	4.4721		22.36	26.83

Twist Tables for Twisting Yarns.

Six Ply.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by		
			4	5	6				4	5	6
1	.17	.4082	1.63	2.04	2.45	51	8.50	2.9155	11.66	14.58	17.49
2	.33	.5774	2.31	2.89	3.46	52	8.67	2.9439	11.78	14.72	17.66
3	.50	.7071	2.83	3.54	4.24	53	8.83	2.9721	11.89	14.86	17.83
4	.67	.8165	3.27	4.08	4.90	54	9.	3.	12.	15.	18.
5	.83	.9129	3.65	4.56	5.48	55	9.17	3.0277	12.11	15.14	18.17
6	1.	1.	4.	5.	6.	56	9.33	3.0551	12.22	15.28	18.33
7	1.17	1.0801	4.32	5.40	6.48	57	9.50	3.0822	12.33	15.41	18.49
8	1.33	1.1547	4.62	5.77	6.93	58	9.67	3.1091	12.44	15.55	18.65
9	1.50	1.2247	4.90	6.12	7.35	59	9.83	3.1358	12.54	15.68	18.81
10	1.67	1.2910	5.16	6.45	7.75	60	10.	3.1623	12.65	15.81	18.97
11	1.83	1.3540	5.42	6.77	8.12	61	10.17	3.1885	12.75	15.94	19.13
12	2.	1.4142	5.66	7.07	8.49	62	10.33	3.2145	12.86	16.07	19.29
13	2.17	1.4720	5.89	7.36	8.83	63	10.50	3.2404	12.96	16.20	19.44
14	2.33	1.5275	6.11	7.64	9.17	64	10.67	3.2659	13.06	16.33	19.60
15	2.50	1.5811	6.32	7.91	9.49	65	10.83	3.2914	13.17	16.46	19.75
16	2.67	1.6330	6.53	8.16	9.80	66	11.	3.3166	13.27	16.58	19.90
17	2.83	1.6833	6.73	8.42	10.10	67	11.17	3.3417	13.37	16.71	20.05
18	3.	1.7321	6.93	8.66	10.39	68	11.33	3.3665	13.47	16.83	20.20
19	3.17	1.7795	7.12	8.90	10.68	69	11.50	3.3912	13.56	16.96	20.35
20	3.33	1.8257	7.30	9.13	10.95	70	11.67	3.4157	13.66	17.08	20.49
21	3.50	1.8708	7.48	9.35	11.22	71	11.83	3.4400	13.76	17.20	20.64
22	3.67	1.9149	7.66	9.57	11.49	72	12.	3.4641	13.86	17.32	20.78
23	3.83	1.9579	7.83	9.79	11.75	73	12.17	3.4881	13.95	17.44	20.93
24	4.	2.	8.	10.	12.	74	12.33	3.5119	14.05	17.56	21.07
25	4.17	2.0412	8.16	10.21	12.25	75	12.50	3.5355	14.14	17.68	21.21
26	4.33	2.0817	8.33	10.41	12.49	76	12.67	3.5590		17.80	21.35
27	4.50	2.1213	8.49	10.61	12.73	77	12.83	3.5824		17.91	21.49
28	4.67	2.1602	8.64	10.80	12.96	78	13.	3.6056		18.03	21.63
29	4.83	2.1985	8.79	10.99	13.19	79	13.17	3.6286		18.14	21.77
30	5.	2.2361	8.94	11.18	13.42	80	13.33	3.6515		18.26	21.91
31	5.17	2.2730	9.09	11.37	13.64	81	13.50	3.6742		18.37	22.05
32	5.33	2.3094	9.24	11.55	13.86	82	13.67	3.6969		18.48	22.18
33	5.50	2.3452	9.38	11.73	14.07	83	13.83	3.7192		18.60	22.32
34	5.67	2.3805	9.52	11.90	14.28	84	14.	3.7417		18.71	22.45
35	5.83	2.4152	9.66	12.08	14.49	85	14.17	3.7639		18.82	22.58
36	6.	2.4495	9.80	12.25	14.70	86	14.33	3.7859		18.93	22.72
37	6.17	2.4833	9.93	12.42	14.90	87	14.50	3.8079		19.04	22.85
38	6.33	2.5166	10.07	12.58	15.10	88	14.67	3.8297		19.15	22.98
39	6.50	2.5495	10.20	12.75	15.30	89	14.83	3.8514		19.26	23.11
40	6.67	2.5820	10.53	12.91	15.49	90	15.	3.8730		19.36	23.24
41	6.83	2.6141	10.46	13.07	15.68	91	15.17	3.8944		19.47	23.37
42	7.	2.6458	10.58	13.23	15.87	92	15.33	3.9158		19.58	23.49
43	7.17	2.6771	10.71	13.39	16.06	93	15.50	3.9370		19.69	23.62
44	7.33	2.7080	10.83	13.54	16.25	94	15.67	3.9582		19.79	23.75
45	7.50	2.7386	10.95	13.69	16.43	95	15.83	3.9791		19.90	23.87
46	7.67	2.7689	11.08	13.84	16.61	96	16.	4.		20.	24.
47	7.83	2.7988	11.20	13.99	16.79	97	16.17	4.0208		20.10	24.12
48	8.	2.8284	11.31	14.14	16.97	98	16.33	4.0415		20.21	24.25
49	8.17	2.8577	11.43	14.29	17.15	99	16.50	4.0620		20.31	24.37
50	8.33	2.8868	11.55	14.43	17.32	100	16.67	4.0825		20.41	24.49

Light Running Reel.



The arms of this reel are not adjustable, but are furnished of proper lengths to wind skeins of 54, 60, 72, or 90 inches as ordered. The reel shaft is made of gas pipe with malleable iron spiders, and is well trussed. A simple device releases two of the bars when doffing, the force of gravity alone bringing them again into working position. The skeins are removed through the opening shown in the cut in the circle at the right hand end of reel. This is closed or opened at will by a segment of the circle sliding in its own circumference. This device renders it unnecessary to remove the reel shaft from its journal, thus obviating the danger of breakage. The stop motion is applied in such a manner as not to interfere with the action of the clock, which is arranged to register any number of yards required. The gears, regulating clocks, and stop motion are so disposed as to be entirely out of the way of the operator. The machine can be tended entirely from the front side, so that two reels may be placed back to back, thus economizing floor space. The reels are made to wind from 40 to 50 skeins at a time. The spindles have independent and adjustable friction, for creating more or less friction, and are spaced as ordered, $3\frac{1}{8}$ inches being the maximum, from center to center.

Driving Pulleys:—12 in. dia. 2 in. face. Speed from 125 to 150 revolutions per minute.

Floor Space:—For 50 spindle reel $3\frac{1}{8}$ in. space, 15 ft. 2 in. long, 2 ft. 9 in. wide over all when winding 90 inch skeins.

For Production see table.

Adjustable Reel.

REELS are usually made with 50 spindles each, winding 50 skeins at a time.

SPINDLES:—$3\frac{1}{8}$ in. from center to center.

SPINDLES have independent and adjustable friction, for creating more or less tension.

DRIVING PULLEYS:—12 in. dia., 2 in face. Speed from 125 to 150 revolutions per minute.

WIDTH:—3 ft. 9 in. when winding 90 inch skeins.

REEL, adjustable to 54, 60, 72 and 90 in. circumference.

REGISTERING BELL is arranged with worms, and worm gears, to give each of the above size skeins.

REEL SHAFT of gas pipe, with malleable iron spiders.

REEL PRODUCTION TABLES.

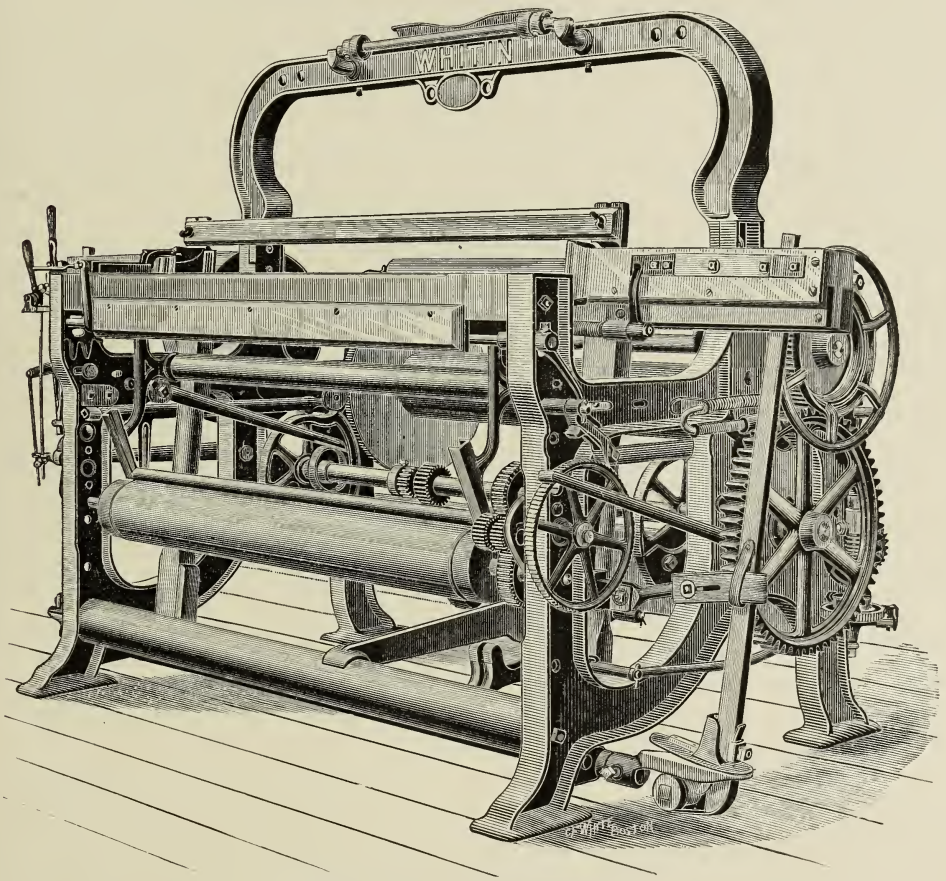
54 IN. REEL.	Revolutions per Minute.						60 IN. REEL.	Revolutions per Minute.					
No. Yarn.	125	130	135	140	145	150	120	125	130	135	140	145	No. Yarn.
1	50.22	52.24	54.24	56.25	58.26	60.27	53.57	55.81	58.04	60.27	62.50	64.74	1
2	25.11	26.12	27.12	28.12	29.13	30.14	26.79	27.91	29.02	30.14	31.25	32.37	2
3	16.74	17.41	18.08	18.75	19.42	20.09	17.86	18.60	19.35	20.09	20.84	21.58	3
4	12.55	13.06	13.56	14.07	14.57	15.07	13.40	13.95	14.51	15.07	15.62	16.18	4
5	10.04	10.45	10.85	11.25	11.65	12.06	10.72	11.16	11.61	12.06	12.50	12.95	5
6	8.37	8.71	9.03	9.38	9.71	10.05	8.93	9.30	9.67	10.05	10.42	10.79	6
7	7.17	7.46	7.75	8.04	8.33	8.61	7.66	7.97	8.29	8.61	8.93	9.25	7
8	6.28	6.53	6.78	7.04	7.28	7.54	6.70	6.98	7.26	7.54	7.82	8.09	8
9	5.58	5.81	6.03	6.25	6.48	6.70	5.95	6.20	6.45	6.70	6.95	7.20	9
10	5.02	5.23	5.43	5.63	5.83	6.03	5.36	5.58	5.81	6.03	6.25	6.48	10
11	4.56	4.75	4.93	5.12	5.30	5.48	4.87	5.08	5.28	5.48	5.64	5.89	11
12	4.18	4.36	4.52	4.69	4.86	5.02	4.46	4.65	4.84	5.02	5.21	5.40	12
13	3.86	4.02	4.17	4.33	4.48	4.64	4.12	4.29	4.47	4.64	4.81	4.98	13
14	3.58	3.73	3.88	4.02	4.16	4.30	3.83	3.99	4.15	4.31	4.47	4.63	14
15	3.34	3.48	3.62	3.75	3.89	4.02	3.57	3.72	3.87	4.02	4.17	4.32	15
16	3.14	3.27	3.39	3.52	3.64	3.77	3.35	3.49	3.63	3.77	3.91	4.05	16
17	2.95	3.08	3.20	3.31	3.43	3.55	3.15	3.29	3.42	3.55	3.68	3.81	17
18	2.79	2.90	3.02	3.13	3.24	3.35	2.98	3.10	3.23	3.35	3.47	3.59	18
19	2.65	2.75	2.85	2.96	3.07	3.17	2.82	2.99	3.06	3.17	3.29	3.41	19
20	2.51	2.61	2.70	2.82	2.92	3.02	2.68	2.79	2.90	3.02	3.13	3.24	20
21	2.40	2.49	2.58	2.68	2.78	2.87	2.55	2.66	2.77	2.87	2.98	3.08	21
22	2.28	2.38	2.47	2.56	2.65	2.74	2.44	2.54	2.64	2.74	2.84	2.95	22
23	2.19	2.27	2.36	2.45	2.54	2.62	2.33	2.43	2.53	2.62	2.72	2.82	23
24	2.10	2.18	2.26	2.35	2.43	2.51	2.24	2.33	2.42	2.51	2.61	2.69	24
25	2.01	2.09	2.17	2.25	2.33	2.41	2.15	2.23	2.32	2.41	2.50	2.59	25
26	1.93	2.01	2.09	2.17	2.24	2.32	2.06	2.15	2.23	2.32	2.41	2.49	26
27	1.86	1.94	2.01	2.09	2.16	2.23	1.99	2.07	2.15	2.23	2.32	2.40	27
28	1.80	1.87	1.94	2.01	2.08	2.15	1.92	2.00	2.08	2.15	2.23	2.31	28
29	1.73	1.80	1.87	1.94	2.01	2.08	1.85	1.93	2.00	2.08	2.16	2.23	29
30	1.68	1.74	1.81	1.88	1.94	2.01	1.79	1.86	1.94	2.01	2.09	2.16	30

Note : — Result in pounds per spindle per day. Allowance is made in above table for doffing, etc.

REEL PRODUCTION TABLES.

72 IN. REEL.	Revolutions per Minute.						90 IN. REEL.	Revolutions per Minute.					
No. Yarn.	110	115	120	125	130	135	100	105	110	115	120	125	No. Yarn.
1	58.93	61.61	64.29	66.97	69.65	72.33	66.97	70.31	73.66	77.01	80.36	83.71	1
2	29.47	30.81	32.15	33.49	34.83	36.16	33.49	35.16	36.83	38.51	40.18	41.86	2
3	19.65	20.54	21.43	22.33	23.22	24.11	22.32	23.44	24.56	25.67	26.78	27.90	3
4	14.74	15.40	16.07	16.74	17.41	18.08	16.74	17.58	18.42	19.26	20.09	20.93	4
5	11.79	12.32	12.86	13.40	13.93	14.47	13.40	14.06	14.73	15.40	16.07	16.74	5
6	9.82	10.27	10.72	11.16	11.61	12.05	11.16	11.72	12.33	12.84	13.40	13.95	6
7	8.42	8.73	9.19	9.57	9.95	10.33	9.57	10.05	10.53	11.00	11.48	11.96	7
8	7.37	7.70	8.04	8.37	8.71	9.04	8.37	8.79	9.21	9.63	10.05	10.47	8
9	6.55	6.85	7.15	7.44	7.74	8.04	7.44	7.81	8.19	8.56	8.93	9.30	9
10	5.90	6.16	6.43	6.70	6.97	7.23	6.70	7.03	7.37	7.70	8.04	8.37	10
11	5.36	5.60	5.85	6.09	6.33	6.58	6.09	6.39	6.70	7.00	7.31	7.61	11
12	4.91	5.14	5.36	5.58	5.81	6.03	5.58	5.86	6.14	6.42	6.70	6.98	12
13	4.54	4.74	4.95	5.15	5.36	5.57	5.15	5.41	5.66	5.93	6.18	6.44	13
14	4.21	4.40	4.59	4.79	4.97	5.17	4.79	5.03	5.26	5.50	5.74	5.98	14
15	3.93	4.11	4.29	4.47	4.64	4.82	4.47	4.69	4.91	5.14	5.36	5.58	15
16	3.69	3.85	4.02	4.19	4.36	4.52	4.19	4.40	4.61	4.82	5.02	5.23	16
17	3.47	3.63	3.78	3.94	4.20	4.26	3.94	4.14	4.34	4.53	4.73	4.93	17
18	3.28	3.43	3.57	3.72	3.87	4.02	3.72	3.91	4.09	4.28	4.47	4.65	18
19	3.10	3.24	3.39	3.53	3.67	3.81	3.53	3.70	3.88	4.05	4.23	4.41	19
20	2.95	3.08	3.22	3.35	3.49	3.62	3.35	3.52	3.69	3.85	4.02	4.19	20
21	2.81	2.94	3.06	3.19	3.32	3.45	3.19	3.35	3.51	3.67	3.83	3.99	21
22	2.68	2.80	2.92	3.05	3.17	3.29	3.05	3.20	3.35	3.50	3.66	3.81	22
23	2.56	2.68	2.80	2.91	3.03	3.15	2.91	3.06	3.21	3.35	3.50	3.64	23
24	2.46	2.57	2.68	2.79	2.90	3.02	2.79	2.93	3.07	3.21	3.35	3.49	24
25	2.36	2.47	2.57	2.68	2.79	2.90	2.68	2.81	2.95	3.08	3.22	3.35	25
26	2.27	2.37	2.47	2.58	2.68	2.78	2.58	2.71	2.84	2.96	3.09	3.22	26
27	2.19	2.28	2.38	2.48	2.58	2.68	2.48	2.61	2.73	2.85	2.98	3.10	27
28	2.11	2.20	2.30	2.39	2.49	2.58	2.39	2.51	2.63	2.75	2.87	2.99	28
29	2.03	2.13	2.22	2.31	2.40	2.50	2.31	2.43	2.54	2.66	2.77	2.89	29
30	1.97	2.06	2.15	2.23	2.32	2.41	2.23	2.35	2.46	2.57	2.68	2.79	30

Note : — Result in pounds per spindle per day. Allowance is made in above table for doffing, etc.



NEW HEAVY PATTERN LOOM.

New Heavy Pattern Loom.

Designed for Standard Sheetings and Shirtings.

The sides and arch of this Loom are made very heavy in order to stand the high speed of running demanded, and the extra strain thereby induced. On account of this extra weight it will be found to be an excellent machine for standard goods where a large production is required. It has the ordinary cam-harness motion, and by the use of a short auxiliary cam-shaft, geared to the main cam-shaft can be readily and quickly changed to two, three, four or five leaf work as needed, the cams being made in sets that are interchangeable with each other to further facilitate this arrangement. Weavers who have been called upon to make changes in twill work can appreciate the advantages of this construction. The cam-shaft proper is not disturbed in the least, the necessary change gears being put on when loom is set up, thus doing away with all trouble of re-setting pick cams, eccentric, cam-shaft boxes, etc. The cams themselves have been entirely remodeled, so as to give the easiest harness motion possible. When desired the loom is made with an adjustable arch, by means of which extra harness space may be obtained.

When so ordered, our looms are now built so that the Draper Automatic Filling Changer can be applied. When so built, the swell on the Shuttle Box is placed on the back side of the Lathe, and the Loom "Protects" from the Loom side instead of from the Breast Beam as in the regular pattern.

RADIUS OF CRANK:—2 in., $2\frac{1}{4}$ in., $2\frac{1}{2}$ in., $2\frac{3}{4}$ in., 3 in. Side shaft tappet ball shuttle motion. Brake on driving pulleys. Beam Heads 12 in., 13 in., 14 in., 15 in., 16 in. and $16\frac{1}{2}$ in. diameter. Cut Roll Stands arranged for cuts 8 in., 12 in., 16 in., 19 in. and 22 in diameter. Improved Bartlett Geared Let-off Motion, or Friction Let-off. Shuttle Box 18 in. to 24 in. long. Friction Driving Pulleys furnished if desired. Belt from above or below. Made to weave plain two shade work; also 3, 4, and 5 shade twill. The change pick motion is arranged so that one tooth in the gear stands for two picks in the cloth, i. e.: 50 teeth in the gear give 100 picks in the cloth, etc. The gears range from 20 to 54 teeth, varying each one tooth. The pick motion may be arranged to give any required number of picks to the inch, but where more than 108 or less than 40 picks are wanted, the ratio between the change pick gear and the number of picks in the cloth, will not be constant as above. The Tape Selvage Motion may be conveniently applied.

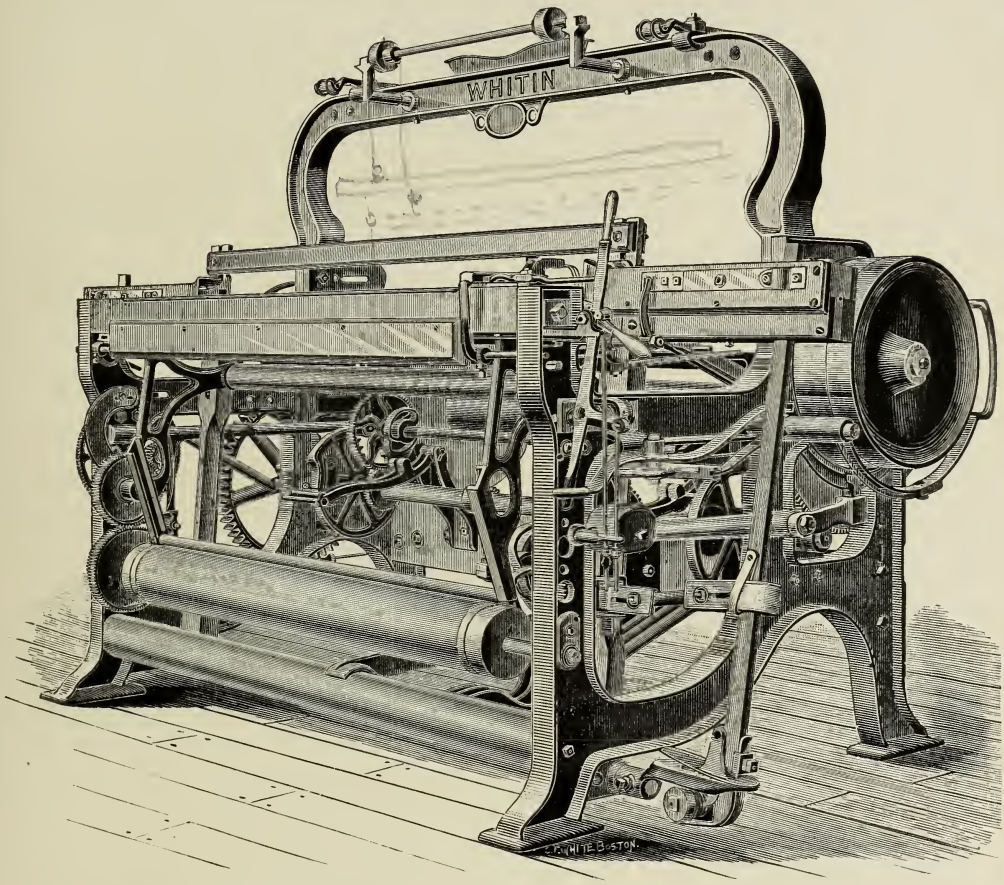
PULLEYS:—10 in. to 15 in. diameter, 2 in. face, and run from 140 to 200 revolutions per minute.

TABLES:—See Tables of Production and Floor Space.

New Heavy Pattern Loom.

(Ponemah Side)

Designed for use with Multiple Harnesses.



This pattern is the same as our new Heavy Loom except that there is 3 inches more space between the breast beam and the arch. It is used very successfully with a dobby head, and when so used is not provided with the arch. The treadles, cams, and harness rolls are also left off. The loom is made with or without adjustable arch. Reference to the cut will show the tape selvedge motion as applied to this loom. Loom may be arranged for cut 22 in. diameter.

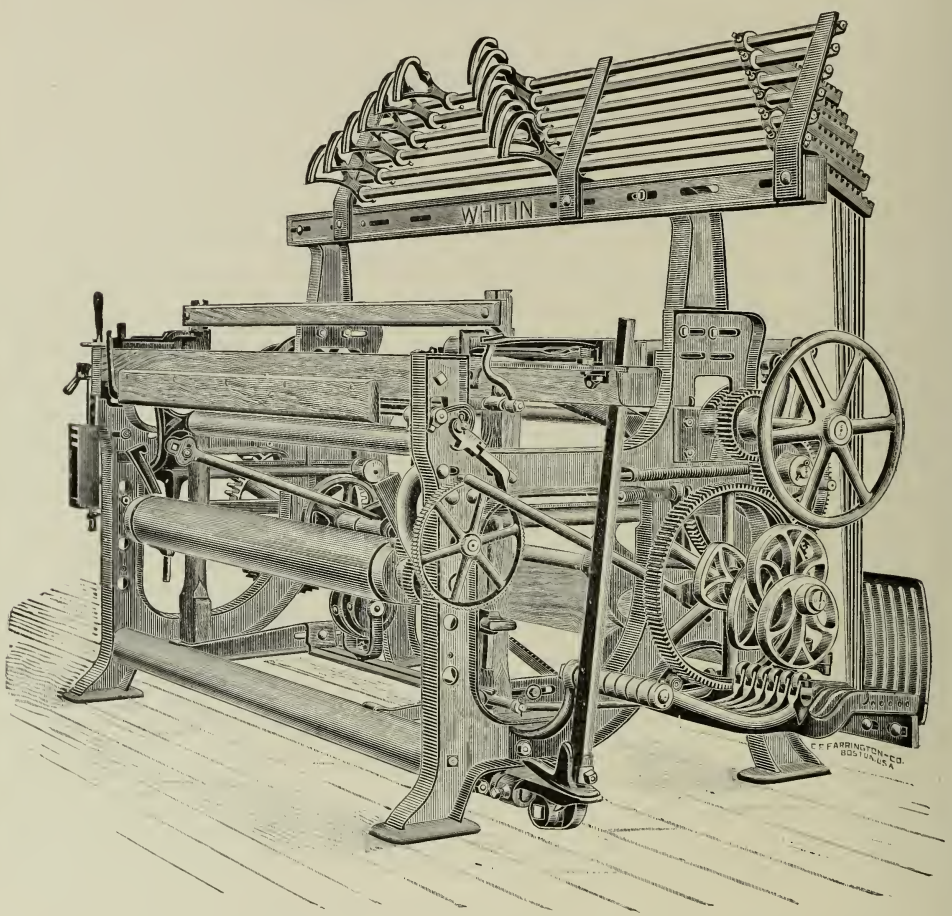
RADIUS OF CRANKS:—2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$ and 3 in. Side shaft tappet ball shuttle motion. Beam heads 12, 13, 14, 15, 16 and $16\frac{1}{2}$ in. diameter. Geared let-off motion. Shuttle boxes 18 and 20 in. long. Made to weave plain 2 shade work, also 3, 4 and 5 shade twill. Arrangement of change pick motion same as in new Heavy Pattern Loom.

PULLEYS:—10, 12 and 14 in. diameter, 2 in. face, and run 140 to 180 revolutions per minute.

TABLES:—See Tables of Production and Floor Space.

New Heavy Pattern Loom.

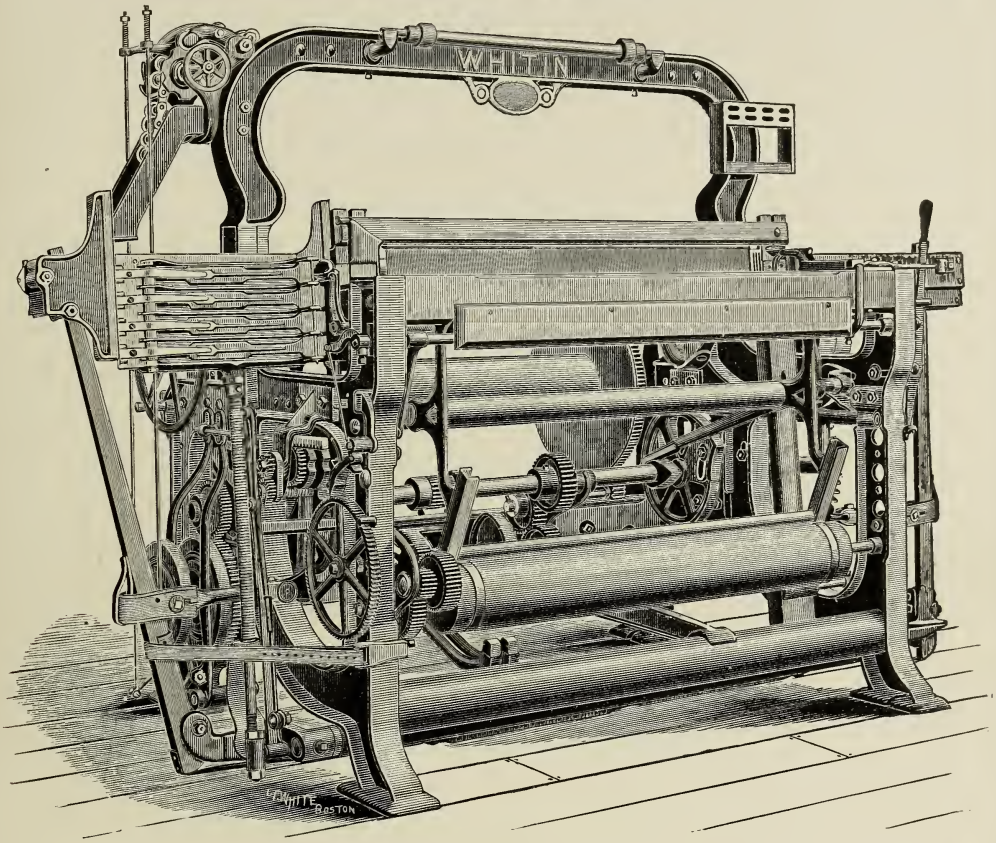
With Outside Cams.



It will be seen from the foregoing cut that the general construction of this Loom is the same as that of our regular Heavy Pattern with Ponemah Side. The chief departure consists in placing the harness cams and treadles on the outside of the Loom; the great advantage resulting therefrom being in the handiness and convenience of making changes where they are frequently required. The Loom is built to weave plain 2 shade work, and also 3, 4, 5 and 6 shade twill. When used for 3 or 4 shade twill work, there is still room outside of the Loom for a plain selvedge motion. The outside cams are so arranged that they come inside the end of the lathe, so that Looms built in this way do not require extra floor space on this account.

TABLES:—See Tables of Production and Floor Space.

The Box Loom.



This loom is particularly adapted to the work of weaving ginghams, cottonades and plaids generally. It has the ordinary cam-harness motion, and by the use of a short auxiliary cam-shaft, geared to the main cam-shaft can be readily and quickly changed to two, three, four, or five leaf-work as needed, the cams being made in sets that are interchangeable with each other to further facilitate this arrangement. Weavers who have been called upon to make changes in twill work can appreciate the advantages of this construction. The cam shaft proper is not disturbed in the least, the necessary change gears being put on when loom is set up, thus doing away with all trouble of re-setting pick cams, eccentric, cam-shaft boxes, etc. The loom is made much heavier than heretofore, the sides having nearly one hundred pounds more iron in each, to stand the higher speed of running demanded, and the extra strain thereby induced.

The general favor that has been accorded to this improved machine demonstrates its worth and acceptability to manufacturers. It is generally furnished with the "side pick," this form of pick motion being conceded to be the best for high speeds.

The box-motion as applied has the special claim of simplicity as its greatest merit, while accomplishing all that other and more intricate styles do. It is composed of comparatively few parts, requiring little skill and experience to understand the mechanism and to make the changes for weaving various patterns.

The boxes are carried positively into position, whether up or down, and are balanced so that the action is smooth, direct and sure, thus getting rid of the liability of making miss-patterns, as experienced in some styles of box-motions. The pattern-chain is very simple to "read," owing to the fact that a particular phase, of which there are four, always calls for a particular box, no matter what the position of the preceding box may happen to be. This fact remains in all cases without regard to the intricacy of pattern being woven.

By a novel arrangement the revolving or turning of the pattern-chain is arrested whenever the filling breaks or runs out, thereby disposing of the trouble of setting the chain back to compensate for the number of revolutions taken, with no color going into the cloth. Further, the box from which the filling has been exhausted is always "fair" with the race plate, so that the empty shuttle can be easily taken out and a full one substituted.

The movement of the boxes is controlled by a set of cams that revolve constantly while the loom is running, and have large wearing surfaces.

These surfaces are constructed so as to move the boxes slowly at each end of the throw and quickly in the center so as to start and stop without jar. The connection between these cams and the lifting mechanism proper is very direct, doing away to the last degree with joints and parts that will affect the throw of boxes by becoming worn and loose.

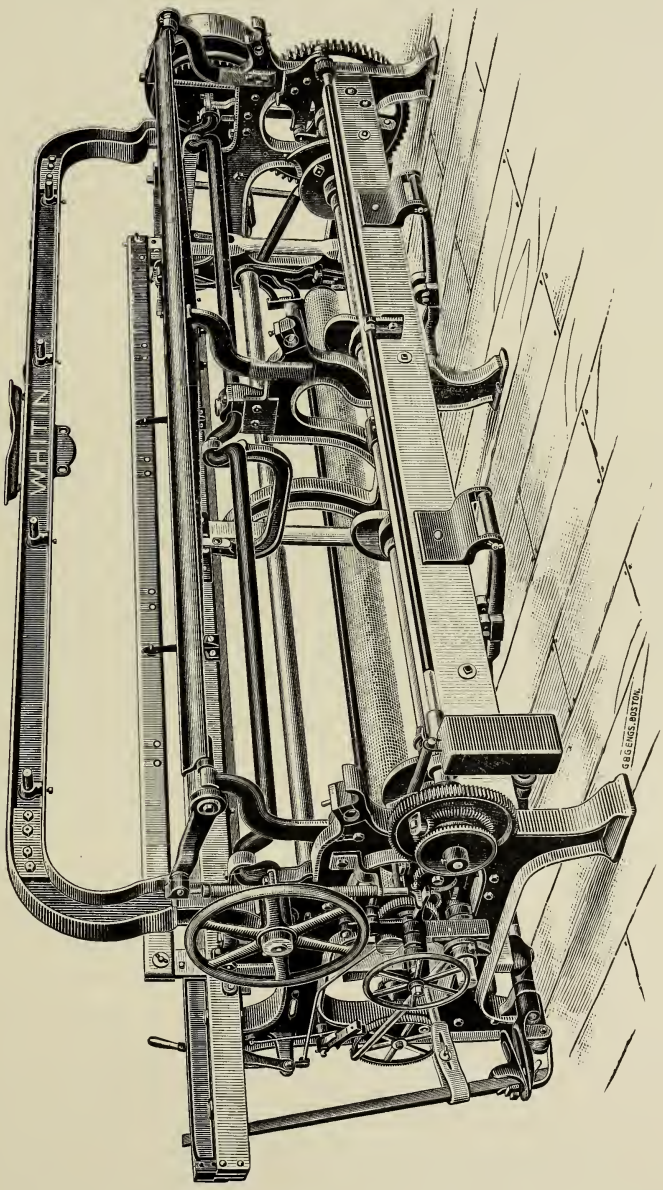
The connection of the lifting mechanism proper and the box-rod is also direct, so there is no lost motion at this point. The fact that there are so few parts, and each point being made with large bearing surfaces, fitted in the best manner possible, brings the cost of maintenance down to the lowest point and enables the loom to be run at a high rate of speed without detriment to the working parts. The action at all places is smooth, and time allowance is ample for the fastest speeds.

This loom is built for either two or four boxes at one end and one at the other. Any one of the series of boxes can be presented at a level with the shuttle race (according to the demands of the pattern being woven), and firmly locked there until the pattern-chain indicates a change, when another box takes its place and is in turn locked as before.

The lifting and lowering of boxes is done by the well-known crank movement, thereby carrying out the idea of a slow start and stop, with accelerated motion at the center of the "throw," that is already considered in the large actuating cams. The crank always stops on the "dead center," thereby locking the boxes at each point.

Driving Pulleys are 12 and 14 in. diameter, 2 in face, and run from 140 to 180 revolutions per minute.

Table:—See Table of Production.



WIDE LOOM.

The Wide Loom.

Designed for Wide Sheetings, Etc.

These Looms are intended to take the place of the old Lyall Loom for weaving goods from 72 to 130 inches wide. They are built with a very heavy side and are further strengthened with a middle tie. This Loom has 4 inches more harness space than the old pattern Loom, and much heavier sides. The crank shaft is provided with three cranks radius of which is 3 inches. A scroll pick motion with tappets is used, and has been made extra strong and effective. Looms are built with or without brake on driving pulleys. Beam Heads 12, 13, 14, 15, 16, and 16½ inches in diameter. Our wide Looms are equipped with two beams, and to ensure even tension of the yarn as it comes off both beams, are usually built with a compound let-off motion. Shuttle boxes 20, 22, or 24 inches long. Arranged to belt from above or below and for plain 2 shade work, or for 3, 4, or 5 shade twill work. When used for twills, the Loom is built with an auxiliary shaft. The change pick motion is arranged in the same manner as in our other Looms, that is, one tooth in the gear stands for two picks in the cloth, etc. The gears range from 20 teeth to 54 teeth, varying each one tooth.

PULLEYS:—15, 16, and 17 inches in diameter, 3 inch face, and for 108 inch Loom run 90 revolutions per minute, varying correspondingly for other sizes.

TABLES:—See Tables of Production and Floor Space.

Table showing the number of yards of Cloth produced in one day of 10 hours.

No. of Picks per inch.	REVOLUTIONS OF CRANK SHAFT PER MINUTE.											No. of Picks per inch.
	100	110	120	130	140	150	160	170	180	190	200	
	YDS.	YDS.	YDS.	YDS.	YDS.	YDS.	YDS.	YDS.	YDS.	YDS.	YDS.	
50	30.000	33.000	36.000	39.000	42.000	45.000	48.000	51.000	54.000	57.000	60.000	50
54	27.778	30.556	33.333	36.111	38.889	41.667	44.445	47.222	50.000	52.778	55.556	54
56	26.786	29.464	32.143	34.822	37.511	40.189	42.857	45.536	48.215	50.893	53.572	56
60	25.000	27.500	30.000	32.500	35.000	37.500	40.000	42.500	45.000	47.500	50.000	60
64	23.437	25.781	28.125	30.469	32.813	35.157	37.501	39.845	42.189	44.533	46.877	64
66	22.727	25.000	27.273	29.546	31.819	34.092	36.365	38.638	40.911	43.184	45.457	66
68	22.052	24.257	26.462	28.667	30.872	33.077	35.282	37.487	39.692	41.897	44.102	68
70	21.429	23.572	25.715	27.858	30.001	32.144	34.287	36.430	38.573	40.716	42.859	70
72	20.833	22.916	24.999	27.082	29.165	31.248	33.331	35.414	37.497	39.580	41.663	72
74	20.270	22.297	24.324	26.351	28.378	30.405	32.432	34.459	36.486	38.513	40.540	74
76	19.737	21.711	23.684	25.658	27.632	29.605	31.579	33.553	35.526	37.500	39.474	76
78	19.231	21.154	23.077	25.000	26.923	28.846	30.769	32.692	34.616	36.539	38.462	78
80	18.750	20.625	22.500	24.375	26.250	28.125	30.000	31.875	33.750	35.625	37.500	80
84	17.857	19.643	21.429	23.214	25.000	26.786	28.571	30.357	32.143	33.928	35.714	84
88	17.455	19.200	20.946	22.691	24.437	26.182	27.928	29.673	31.419	33.164	34.910	88
92	16.304	17.935	19.565	21.196	22.826	24.456	26.087	27.717	29.348	30.978	32.608	92
96	15.625	17.188	18.750	20.313	21.875	23.438	25.000	26.563	28.125	29.688	31.250	96
100	15.000	16.500	18.000	19.500	21.000	22.500	24.000	25.500	27.000	28.500	30.000	100
104	14.519	15.971	17.423	18.875	20.327	21.779	23.231	24.683	26.134	27.586	29.038	104
108	13.889	15.278	16.667	18.056	19.445	20.833	22.222	23.611	25.000	26.389	27.778	108
112	13.393	14.732	16.071	17.411	18.750	20.089	21.429	22.768	24.107	25.447	26.785	112
116	12.931	14.224	15.517	16.810	18.103	19.397	20.690	21.983	23.276	24.569	25.862	116
120	12.500	13.750	15.000	16.250	17.500	18.750	20.000	21.250	22.500	23.750	25.000	120

NOTE.—In the above tables, 10 per cent. of the time is allowed for changing shuttle, cleaning, oiling, tc.

Table of Floor Space Required for the Whitin Loom.

Name of Loom.	Length of Lay.		* Width from outside Breast Beam to outside of 16½ in. Warp Beam.		Distance between Swords.	Reed Space.
	Feet.	Inches.	Feet.	Inches.	Inches	Inches.
28 inch.	6	3 5/8	3	6 3/4	35	32 1/2
30 "	6	5 1/8	3	6 3/4	36 1/2	34
31 "	6	6 5/8	3	6 3/4	38	35 1/2
32 "	6	7 5/8	3	6 3/4	39	36 1/2
33 "	6	8 5/8	3	6 3/4	40	37 1/2
34 "	6	9 5/8	3	6 3/4	41	38 1/2
36 "	6	11 5/8	3	6 3/4	43	40 1/2
38 "	7	1 5/8	3	6 3/4	45	42 1/2
40 "	7	3 5/8	3	6 3/4	47	44 1/2
42 "	7	5 5/8	3	6 3/4	49	46 1/2
44 "	7	7 5/8	3	6 3/4	51	48 1/2
46 "	7	9 5/8	3	6 3/4	53	50 1/2
50 "	8	1 5/8	3	6 3/4	57	54 1/2
54 "	8	6 1/8	3	6 3/4	61 1/2	59
56 "	8	8 1/8	3	6 3/4	63 1/2	61
60 "	9	5/8	3	6 3/4	68	65 1/2
66 "	9	6 5/8	3	6 3/4	74	71 1/2
72 "	10	4	3	11 3/4	80	77 1/2
80 "	11	0	3	11 3/4	88	85 1/2
82 "	11	2	3	11 3/4	90	87 1/2
90 "	11	10	3	11 3/4	98	95 1/2
92 "	12	0	3	11 3/4	100	97 1/2
100 "	12	8	3	11 3/4	108	105 1/2
102 "	12	10	3	11 3/4	110	107 1/2
108 "	13	4	3	11 3/4	116	113 1/2
112 "	13	8	3	11 3/4	120	117 1/2
128 "	15	0	3	11 3/4	136	133 1/2

NOTE:—The above table has for its basis our regular standard 40 in. heavy pattern loom. The name of loom in the left hand column is so given largely for convenience, and the number of inches given is not intended to indicate the exact width of cloth, as this will vary according to quality of cotton used, number of picks and number of yarn, etc. In the list above 28 to 72 inch looms, inclusive, are assumed to have shuttle boxes 20 5/16 in. long, which is a suitable length for 15 in. shuttles. From 72 in. upwards, a 22 in. box is used. We make boxes 18, 19, 20, 21, 22 and 23 in. long, and when variations are made from sizes of boxes assumed as standards above, there will be a corresponding variation in the length of lay.

***To obtain width from outside of Breast Beam to outside of 16½ in. Warp Beam of the following styles of Looms, add the following number of inches to the figures given above:**

Wide Loom, Standard Pattern,	5¼ inches.
Wide Loom, Dwight Pattern,	3¼ "
Heavy Pattern Loom, Ponemah Side,	3 "
Loom with outside Cams, Ponemah Side,	3 "

Average Power Consumed by Cotton Machinery.

Pickers,			6 to 8 H. P.
Cards,			$\frac{1}{5}$ to $\frac{1}{3}$ "
Railway Head and Card Connection,			$\frac{3}{4}$ to $1\frac{1}{2}$ "
Doubler,			$1\frac{1}{4}$ to $2\frac{1}{2}$ "
Drawing, 4 deliverers,			$1\frac{1}{2}$ "
Coarse Speeder,	27 to 33	Spindles per	"
Intermediate Speeder,	37 to 50	"	"
Fine Speeder,	42 to 51	"	"
Slubber Fly Frame,	40 to 50	"	"
Intermediate Fly Frame,	70 to 80	"	"
Fine Fly Frame,	100 to 120	"	"
Ring Spindle, Common,	70 to 120	"	"
Ring Spindle, Sawyer,	90 to 130	"	"
Ring Spindle, Rabbeth,	70 to 120	"	"
Ring Spindle, Gravity,	70 to 120	"	"
Spooler,	250 to 400	"	"
Mule,	160 to 200	"	"
Filling Winders,	300	"	"
Warper,		$\frac{1}{6}$ to $\frac{1}{4}$	"
Slashers,		$1\frac{1}{2}$ to 2	"
Loom,		$\frac{1}{6}$ to $\frac{1}{4}$	"
Duck Loom,		1	"
Yarn Reels,		$\frac{1}{6}$	"
Shears and Brush,		3	"
Folder,		$\frac{1}{8}$	"

Table of Horse-Power which can be safely carried by 1st Movers at different Velocities, Factor of Safety being = 15.5.

SAMUEL WEBBER.

Diameter in Inches.	Revolutions per Minute.						Diameter in Inches.	Revolutions per Minute.			
	50	100	150	200	250	300		50	100	150	200
	Horse-Power.							Horse-Power.			
1	.5	1	1.5	2	2.5	3	6	108	216	324	432
1¼	.975	1.95	2.92	3.9	4.87	5.85	6¼	122.07	244.14	366.21	488
1½	1.68	3.37	5.04	6.74	8.4	10.11	6½	137.31	274.62	411.93	549
1¾	2.68	5.36	8.04	10.72	13.4	16.08	6¾	153.72	307.55	461.16	615
2	4	8	12	16	20	24	7	171.5	343	514.5	686
2¼	5.69	11.39	17.07	22.78	28.45	34.17	7¼	190.54	381.08	571.62	762
2½	7.81	15.62	23.43	31.24	39.05	46.86	7½	210.93	421.87	632.79	843
2¾	10.4	20.8	31.2	41.6	52	62.4	7¾	232.74	465.48	698.22	931
3	13.5	27	40.5	54	67.5	81	8	256	512	768	1,024
3¼	17.16	34.33	51.5	68.66	85.8	103	8¼	280.76	561.52	842	1,123
3½	21.43	42.87	64.29	85.74	107.15	128.61	8½	307.06	614.12	921	1,228
3¾	26.36	52.73	79.08	105.46	131.8	158.19	8¾	334.96	669.92	1,005	1,340
4	32	64	96	128	160	192	9	364.5	729	1,093.5	1,458
4¼	38.38	76.77	115.15	153.54	191.9	230.31	9¼	395.72	791.45	1,187	1,583
4½	45.56	91.12	136.68	182.24	227.8	273.36	9½	428.68	857.37	1,286	1,715
4¾	53.58	107.17	160.75	214.34	267.9	321.54	9¾	463.43	926.86	1,390	1,854
5	62.5	125	187.5	250	312.5	375	10	500	1,000	1,500	2,000
5¼	72.35	144.7	217.05	289.4	361.75	434.1	11	665.5	1,331	1,995	2,662
5½	83.18	166.37	249.54	322.75	415.9	499.11	12	864	1,728	2,592	3,456
5¾	95.05	190.11	285.15	380.22	475.25	570.33	13	1,053.5	2,107	3,160.5	4,214

Table of Horse-Power for Shafting for Long Lines of Transmission or 2d Movers, Factor of Safety being = 7.75.

SAMUEL WEBBER.

Diameter in Inches.	Revolutions per Minute.					Diameter in Inches.	Revolutions per Minute.				
	100	150	200	250	300		100	150	200	250	300
	Horse-Power.						Horse-Power.				
1	2	3	4	5	6	3⅜	77.88	116.83	155.76	194.7	233.64
1⅛	2.88	4.32	5.76	7.2	8.64	3½	85.74	128.61	171.48	214.35	257.22
1¼	3.9	5.85	7.8	9.75	11.7	3⅝	95.25	142.86	190.5	238.1	285.75
1⅜	5.2	7.8	10.4	13	15.6	3¾	105.46	158.19	210.92	263.65	316.38
1½	6.74	10.11	13.48	16.85	20.22	3⅞	116.37	174.54	232.74	290.9	349
1⅝	8.58	12.87	17.16	21.45	25.74	4	128	192	256	320	384
1¾	10.72	16.08	21.44	26.8	32.16	4⅛	140.38	210.57	280.76	351	421.14
1⅞	13.18	19.77	26.36	32.95	39.54	4¼	153.54	230.31	307	383.85	460.62
2	16	24	32.	40	48	4⅜	167.48	251.22	335	418.7	502.48
2⅛	19.19	28.77	38.38	47.95	57.57	4½	182.24	273.36	364.48	455.6	546.72
2¼	22.78	34.17	45.56	56.95	68.34	4⅝	197.86	296.79	395.72	494.65	593.58
2⅜	26.79	40.17	53.58	66.95	80.37	4¾	214.34	321.54	428.68	535.85	643
2½	31.24	46.86	62.48	78.1	93.72	4⅞	231.71	347.55	463.42	579.25	695.73
2⅝	36.18	54.27	72.36	90.45	108.54	5	250	375	500	625	750
2¾	41.6	62.4	83.2	104	124.8	5¼	289.4	434.1	578.8	723.5	868.2
2⅞	47.52	71.28	95	118.8	141.56	5½	332.75	499	665.5	831.87	998.25
3	54	81	108	135	162	5¾	380.22	570.33	760.44	950.55	1,140.66
3⅛	61.02	91.53	122	152.55	183	6	432	648	864	1,080	1,299
3¼	68.66	103	137.32	171.65	206						

Table of Horse-Power for Shafting for Counter Shafts, well supported, or 3d Movers, Factor of Safety being = 5.17.

SAMUEL WEBBER.

Diameter in Inches.	Revolutions per Minute.						
	100	150	200	250	300	350	400
	Horse-Power.						
1	3	4.5	6	7.5	9	10.5	12
1 1/16	3.59	5.37	7.18	9.95	10.77	12.53	14.36
1 1/8	4.27	6.54	8.54	10.9	12.81	15.26	17.08
1 3/16	5.02	7.53	10.04	12.55	15.06	17.57	20.08
1 1/4	5.85	8.77	11.7	14.62	17.55	20.47	23.4
1 5/16	6.78	10.17	13.56	16.95	20.24	23.73	27.12
1 3/8	7.79	11.67	15.58	19.45	23.37	27.23	31.16
1 7/16	8.91	13.35	17.82	22.25	26.73	31.15	35.64
1 1/2	10.11	15.16	20.22	25.27	30.33	35.38	40.44
1 9/16	11.44	17.16	22.88	28.6	34.32	40	45.76
1 5/8	12.87	19.29	25.74	32.15	38.61	45	51.48
1 11/16	14.41	21.6	28.82	36	43.23	50.4	57.64
1 3/4	16.08	24.12	32.16	40.2	48.24	56.28	64.32
1 13/16	17.86	26.79	35.72	44.65	53.58	62.51	71.44
1 7/8	19.77	29.64	39.54	49.4	59.31	69.16	79.08
1 15/16	21.81	32.7	43.62	54.5	65.43	76.3	87.24
2	24	36.	48	60	72	84	96
2 1/16	26.32	39.48	52.64	65.8	79	92.12	105.28
2 1/8	28.78	43.17	57.56	71.95	86.34	100.73	115.12
2 3/16	31.4	47.1	62.8	78.5	94.2	109.9	125.6
2 1/4	34.17	51.25	68.34	85.42	102.51	119.6	136.68
2 5/16	37.09	55.63	74.18	92.72	111.27	129.81	148.36
2 3/8	40.18	60.27	80.36	100.45	120.54	140.63	160.72
2 7/16	43.44	65.16	86.88	108.6	130.32	152.04	173.76
2 1/2	46.87	70.8	93.74	117.17	140.61	164.04	187.48
2 9/16	50.46	75.69	100.92	126.15	151.38	176.61	201.84
2 5/8	54.27	81.4	108.54	135.67	162.81	189.54	217.08
2 11/16	58.23	87.35	116.46	145.57	174.69	203.8	232.92
2 3/4	62.4	93.6	124.8	156	187.2	218.4	249.6
2 13/16	66.74	100.11	133.48	166.85	200.22	233.59	266.96
2 7/8	71.28	106.92	141.56	176.95	213.84	249.49	285.12
2 15/16	76.04	114.96	152.08	190.1	228.12	266.14	304.16
3	81	120.5	162	202.5	243	283.5	324

The above tables are carried out to an extent beyond all probable need, but may possibly be useful in extreme cases ; and it should be remembered that the first length of shaft in a line, which carries the receiving pulley, and has to bear the vertical or lateral strain of the main belt, being also usually of considerable length, should generally be of the size given in the first table.

Table of Power which may by transmitted by Single Belts of different Widths and Velocities, averaging one-sixth of an inch in thickness.

SAMUEL WEBBER.

Width of Belt.	Velocity in Feet per Minute.										
	600	800	1000	1200	1500	2000	2500	3000	3500	4000	5000
	Horse-Power.										
1	1	1.33	1.66	2	2.5	3.33	4.16	5	5.83	6.66	8.33
2	2	2.66	3.33	4	5	6.66	8.33	10	11.66	13.33	16.66
3	3	4	5	6	7.5	10	12.5	15	17.5	20	25
4	4	5.33	6.66	8	10	13.33	16.66	20	23.33	26.66	33.33
5	5	6.66	8.33	10	12.5	16.66	20.83	25	29.16	33.33	41.66
6	6	8	10	12	15	20	25	30	35	40	50
8	8	10.66	13.33	16	20	26.66	33.33	40	46.66	53.33	66.66
10	10	13.33	16.66	20	25	33.33	41.66	50	58.33	66.66	83.33
12	12	16	20	24	30	40	50	60	70	80	100
14	14	18.66	23.33	28	35	46.66	58.33	70	81.66	93.33	116.66
16	16	21.33	26.66	32	40	53.33	66.66	80	93.33	106.66	133.33
18	18	24	30	36	45	60	75	90	105	120	150
20	20	26.66	33.33	40	50	66.66	83.33	100	116.66	133.33	166.66
22	22	29.33	36.66	44	55	73.33	91.66	110	128.33	146.66	183.33
24	24	32	40	48	60	80	100	120	140	160	200
26	26	34.66	43.33	52	65	86.66	108.33	130	151.66	173.33	216.66
28	28	37.33	46.66	56	70	93.33	116.66	140	163.33	186.66	233.33
30	30	40	50	60	75	100	125	150	175	200	250
32	32	42.66	53.33	64	80	106.66	133.33	160	186.66	213.33	266.66
34	34	45.33	56.66	68	85	113.33	141.66	170	198.33	216.66	283.33
36	36	48	60	72	90	120	150	180	210	240	300

When double belts are used, add 70 per cent. to above tables.

HORSE-POWER OF A LACED LEATHER BELT ONE INCH WIDE.

Formula $HP = C\ V\ t\ w\ (T - .012\ V^2) \div 550.$

For $f = .40$ and $@ = 180°$, $C = .715$; $T = 275$; $w = 1''$

Velocity in Feet per Second.	THICKNESS IN INCHES $= t$.						
	$\frac{1}{7}''$ .143	$\frac{1}{6}''$ .167	$\frac{3}{16}''$ .187	$\frac{7}{32}''$ .219	$\frac{1}{4}''$ .250	$\frac{5}{16}''$ .312	$\frac{1}{3}''$ .333
10	.51	.59	.63	.73	.84	1.05	1.18
15	.75	.88	1.00	1.16	1.32	1.66	1.77
20	1.00	1.17	1.32	1.54	1.75	2.19	2.34
25	1.23	1.43	1.61	1.88	2.16	2.69	2.86
30	1.47	1.72	1.93	2.25	2.58	3.22	3.44
35	1.69	1.97	2.22	2.59	2.96	3.70	3.94
40	1.90	2.22	2.49	2.90	3.32	4.15	4.44
45	2.09	2.45	2.75	3.21	3.67	4.58	4.89
50	2.27	2.65	2.98	3.48	3.98	4.97	5.30
55	2.44	2.84	3.19	3.72	4.26	5.32	5.69
60	2.58	3.01	3.38	3.95	4.51	5.64	6.02
65	2.71	3.16	3.55	4.14	4.74	5.92	6.32
70	2.81	3.27	3.68	4.29	4.91	6.14	6.54
75	2.89	3.37	3.79	4.42	5.05	6.31	6.73
80	2.94	3.43	3.86	4.50	5.15	6.44	6.86
85	2.97	3.47	3.90	4.55	5.20	6.50	6.93
90	2.97	3.47	3.90	4.55	5.20	6.50	6.93

V becomes a maximum at 87.41 feet per second,=5245 feet per minute.

HORSE-POWER OF A RIVETED LEATHER BELT ONE INCH WIDE.

Formula as in above Table, except that $T = 400$ instead of 275.

Velocity in Feet per Second.	THICKNESS IN INCHES $= t$.						
	$\frac{7}{32}''$ .219	$\frac{1}{4}''$ .250	$\frac{5}{16}''$ .312	$\frac{1}{3}''$ .333	$\frac{3}{8}''$ .375	$\frac{7}{16}''$ .437	$\frac{1}{2}''$ .500
15	1.69	1.94	2.42	2.58	2.91	3.39	3.87
20	2.24	2.57	3.21	3.42	3.85	4.49	5.13
25	2.79	3.19	3.98	4.25	4.78	5.57	6.37
30	3.31	3.79	4.74	5.05	5.67	6.62	7.58
35	3.82	4.37	5.46	5.83	6.56	7.65	8.75
40	4.33	4.95	6.19	6.60	7.42	8.66	9.90
45	4.85	5 49	6.86	7.32	8.43	9.70	10.98
50	5.26	6.01	7.51	8.02	9.02	10.52	12.03
55	5.68	6.50	8.12	8.66	9.74	11.36	13.00
60	6.09	6.96	8.70	9.28	10.43	12.17	13.91
65	6.45	7.37	9.22	9.83	11.06	12.90	14.75
70	6.78	7.75	9.69	10.33	11.62	13.56	15.50
75	7.09	8.11	10.13	10.84	12.16	14.18	16.21
80	7.36	8.41	10.51	11.21	12.61	14.71	16.81
85	7.58	8.66	10.82	11.55	13.00	15.16	17.32
90	7.74	8.85	11.06	11.80	13.27	15.48	17.69
95	7.90	9.03	11.28	12.04	13.54	15.80	18.06
100	7.96	9.10	11.37	12.13	13.65	15.92	18.20
105	8.00	9.13	11.41	12.17	13.69	15.97	18.26

V becomes a maximum at 105.4 ft. per second=6324 ft. per minute.

In above Tables, the angle of Substension $@$, is taken at 180°.

Should it be	90°	100°	110°	120°	130°	140°	150°	160°	170°	180°	200°
Multiply above values by . .	.65	.70	.75	.79	.83	.87	.91	.94	.97	1.	1.05